Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 71 — New York, Saturday, May 11, 1918 — *Number* 19

Interconnection of Generating Systems Important

WE HAVE so often preached the desirability of physical connection between adjacent generating plants that under ordinary circumstances it would hardly seem necessary to call attention again to its obvious advantages, but the lessons of the last winter and industrial conditions that are rapidly arising impress the need of going further than ever before in the matter of interconnection. The coal problem is still far from completely solved. In fact, the situation may at any time take on an acute phase, so that no plant can feel absolutely secure as regards its fuel supply or its ability to insure continuity of service under all the conditions that may arise. Would it not be wise, therefore, to undertake some concerted action for comprehensive emergency interconnections, so that any station which is through its distribution within reach of another station should make provision for the exchange of current and make it in advance of a sudden necessity?

Numerous cases may arise in which this step would be of very great advantage. Industrial power in considerable amount may be required, for instance, from a plant which is not readily able to supply the added load on short notice. If it is able promptly to borrow energy from a neighbor, work can go ahead speedily; if it has to wait in these strenuous days until new machinery can be installed, important manufactures may be held up. Again, a station with a widespread distribution may require similar assistance from a more conveniently situated neighbor to avoid the investment and loss of time required to reinforce its feeders. A plant may readily be caught in a temporary coal shortage when two or three days of assistance would suffice to tide over the emergency without inconvenience to anybody.

Big plants and small plants alike may need help often on very short notice. Most stations now run a twenty-four-hour service, but there are some small ones which are not conveniently equipped to do so and therefore would be at least temporarily unable to deliver power for manufacturers which otherwise could be profitably handled. The power load is assuming every month great and greater importance. Factories are often situated with reference to considerations more important than power supply, and their needs should be met if possible. The obvious step would seem to be a thoroughly systematized effort at interconnection between adjacent territories. There is a strong enough spirit of comity in these days to enable arrangements of this kind to be made without much difficulty, and the main thing is to make them promptly and to carry out the necessary construction so that if help becomes of vital importance it can be obtained at once. There are innumerable places where with comparatively small expenditure this plan could be carried out, but in most instances it demands material and labor that cannot be summoned on the spur of the moment. Here is a good field for the activities of the National Electric Light Association, which has already done so much in securing united and efficient action for the public service.

Predicting the Residence Load

PREDICTING from past experience the probable growth of load on residence circuits is not so easy. The general method applied by P. O. Reyneau in this issue is substantially that which he has already used in other classes of lighting. He builds up a working curve by adding graphically the sums of the monthly maximum averaged over three years, giving thus a general view of the variations of the past from month to month. For convenience the values from the curves are reduced to a table of percentages in which the load for each month appears as a percentage of the load for every other month in the year. Then, knowing the present load for any given month, one has fairly sound data on which to predict the probable value of the load in some future month. The precision of this prediction of course depends on the reliability of the rate of growth established by the periods entering into the average.

Motor Drive for Woodworking Machines

EVERY sort of machinery has its own idiosyncrasies when one comes to adapt it to electric drive. David R. Shearer's paper in the current issue takes up the situation regarding the application of motors to individual woodworking machines. The general peculiarity of many of these is that the load is irregularly periodic, very heavy at times and light during the intervening periods of inactivity. The tendency in fitting out equipment of this character with electric motors has been to overpower the outfit to a very considerable extent. Group driving reduces the general amount of overloading but does not free the motor from the danger of an aggregate peak as in the case of any group of irregularly loaded machines. Now and then all the loads fall upon the group motor simultaneously, with a fairly good chance of putting it out of service. The remedy is precisely the same in this

case as in that most aggravated example of irregular load, the rolling mill; that is, the installation of a flywheel heavy enough to help out the motor during the brief periods of heavy demand and in storing up energy between peaks for the next effort.

Our contributor's load curves, derived from actual practice, put the case in the clearest possible terms. It is shown that it is perfectly possible to get a very heavy peak, say four times the average load, out of three quite innocent-appearing components. The installation of a flywheel on any single machine produces an immediate and striking effect in smoothing out the load curve. In the example shown the peaks occurring at periods of ten or twelve seconds were brought down to less than two-thirds of their ordinary value, a result which not only is gratifying with respect to the size of motor necessary to install but produces a most salutary result on the power demand from the system at large. With the fairly heavy motor from which these curves were taken the sudden variations in demands for power would be quite sufficient to disturb very seriously the regulation of anything except a large generating plant. With the flywheel working the peaks become relatively inconsequential and the load is very much softened. The case is one which may be found, too, in various other branches of industry in which there are frequent and sharp increases in load. A fairly heavy flywheel, designed with reference to the work to be done, affords a highly successful remedy for these irregularities and not only diminishes the size of motor necessary to install but renders its operation much easier for the plant and saves possible overheating and stalling of the motor itself.

First Fruits of Daylight Saving

THE actual result of daylight saving is something almost impossible to predict save in the most general way. Previous experience abroad has shown that the reduction in demand for energy has been a measurable but very uncertain quantity, varying considerably from place to place. Our readers will therefore welcome a group of load curves obtained from stations in the Middle West showing roughly the actual results thus far obtained in carrying out the daylight-saving program. They apply, of course, to the first month of the new schedule, April, during which the conditions were not yet steadied by every-day experience with the new régime, and when the actual hours of sunrise and sunset had not reached their extreme positions. The main showing thus far is that the reduction in output is of the order of magnitude of 5 per cent for this particular month. This implies, of course, a greater reduction in gross revenue from the fact that the deficit comes out of the lighting rate, which is relatively high.

As respects the load curve of the station, daylight saving has created a new valley in the lighting between 5 and 8 o'clock p. m. The short span of this valley tends to lessen the actual saving in coal, since a large part of the boiler capacity will have to be carried over it ready for service. On the other hand, there has been in some instances a slight increase in the daily load factor which probably is of small significance. The annual load factor will be upon the whole somewhat reduced, to the injury of costs of production. It will be interesting to follow the changes in load as time goes on. For a guess, there will be no striking change for several months to come; but during late September and October the conditions should produce a considerable lessening of the evening valley and the addition of a morning peak. Were the daylight-saving plan carried throughout the year the chances would be good for an improvement in the annual load curve, and particularly that portion of it which lies in the winter months. It would not be surprising, indeed, to see the requirements of energy for lighting through October tending in some material degree to offset the earlier losses. We can only tell by watching just what is going to happen, but it is fairly evident that the saving in fuel is going to be small compared with the possible loss of revenue; that the latter probably will not be so large in the total as has been expected, owing to the effect of the later portion of the daylight-saving period, and that the benefits secured to the public are not to be reckoned so much in the saving of lighting bills as in the advantage to be gained by the added hours of out-of-doors freedom.

Economies of Higher Steam Pressures

WITH the rising price of coal the necessity of its economical use in central stations becomes daily more imperative. The electric generator itself has been pushed pretty nearly to its ultimate efficiency. For example, when a generator is giving 95 per cent efficiency at or near full load the chances of improvement to any material degree whatever are obviously negligible. One must look somewhere else in the line of transformation for a chance to make savings. The mechanical power plant offers this opportunity, from the boilers to the shaft that spins the generator. Within a recent period this journal has published important notes on the savings to be made by larger and better boiler units, by increased vacuum, by saving of waste heat in the piping, and by increasing both pressures and superheat in the steam system. In the current issue J. T. Foster gives the results of a study of the relation of steam pressures to economy, particularly economy of the dollars and cents variety.

That raising the steam pressure increases the thermal efficiency of the prime mover admits of no dispute. Furthermore, it does so to a determinate extent which can be computed with a very satisfactory degree of precision; but as a matter of fact engineers have been very cautious in raising pressures, chiefly for the reason that equipment is not "standard" for pressures materially above 200 lb. (14 kg. per sq. cm.), and, as everybody knows, a request for variation from so-called standards is immediately followed by a punitive expedition in force from the estimating department of the manufacturer. But, as practice has crawled upward from the square-stayed boilers of the olden times and pressures not much higher than those in a vapor-heating system to highly organized water-tube installations at 200 lb. or more per square inch (14 kg. and up), so advance is bound to come from these latter conditions up to the point at which the cost of equipment for added pressure counterbalances the saving to be made, a point which is ever creeping upward as costs of

fuel rise. Mr. Foster's paper gives a very convenient practical method of investigating the economic conditions accompanying increased steam pressure. As a matter of fact, added superheat generally goes with steam pressure, also the best vacuum which is commercially obtainable, but the pressure item alone shows large savings.

The difficult thing to estimate in this, as in all similar cases, is the probable increase of the total cost of the plant in going, say, from 200-lb. to 500-lb. (14-kg. to 35-kg.) normal pressure. We are inclined to think that Mr. Foster's estimates in this particular are somewhat lower than they would run at the present moment, but in more normal times they would sound very reasonable. At all events, these suggestions mark a move in the right direction, as we indicated not long ago in describing the Joliet plant to which Mr. Foster refers. The steam turbine has probably not yet reached its ultimate efficiency in the same sense that the dynamo has, yet it has certainly developed to a point where mere increase of output is not likely to better things materially. There is still room for considerable improvement in boiler plants, chiefly through increase of working capacity. The condenser is fairly near its limits, so that the opportunity for saving lies in superheat and in steam pressure.

The Precise Measurement of Alternating Currents

IN THE electrical engineering laboratory the measurement of continuous currents has ordinarily a higher degree of precision than the measurement of alternating currents. This is for the reason that continuous-current precision measurements commonly employ null methods, whereas alternating-current precision measurements commonly employ deflection methods. The potentiometer, essentially a null-method instrument, is very generally employed in continuous-current work; but although the alternating-current potentiometer exists, it is relatively little known.

The ordinary electrodynamometer for measuring alternating currents is essentially a deflection instrument. Either the scale deflection produced by an alternating current is compared with a similar scale deflection produced by a known continuous current or the deflections are in turn reduced to zero through the application of a scale-measured torque. This scale-reading use of the instrument necessarily limits the precision of its use. The article by C. O. Gibbon in this number describes an interesting and novel use of the dynamometer whereby the torque produced by an alternating current is balanced against the opposing torque produced by a measured continuous current, thereby employing the instrument in a null method and enabling the degree of alternating-current precision to be raised nearly to that of the continuous-current measurement involved. The idea originated in the Bureau of Standards and has been actually tested in a dynamometer especially wound for the purpose. The results obtained indicate that by the use of the null dynamometer about one part in eight hundred could be secured, on the average, or nearly the third order of precision. When, however, certain improvements shall have been made in the instrument it is hoped that the fourth order, or one part in ten thousand, may be approached. We understand that the instrument has been already carried to a further stage of development since the article now printed was written.

The null dynamometer measures the root mean square of a complex harmonic alternating current in terms of the root mean square, or stationary value, of a measured continuous current. It is actually difficult to obtain a check measurement of the instrument unless, as is described in the article, a simple harmonic alternating current, or pure sine wave current, is very nearly realized for the purpose. In such a case the Drysdale a.c.-d.c. potentiometer enables a check to be secured. It seems likely, however, that the precision of the null dynamometer can be made even superior to that of the Drysdale a.c.-d.c. potentiometer, so that an accurate determination of the null dynamometer's precision may be difficult to obtain. However, other direct-current potentiometers are being developed, and the prospects are therefore good of eventually securing almost as high a degree of precision for complex harmonic alternating-current measurement as is already obtainable for continuous currents.

The easiest application of the null-dynamometer principle is to the measurement of alternating currents of the order of a few centiamperes. This is for the reason that the suspended coil can then receive its current supply through thin suspension wires, which have relatively little torsional moment. The amount of unbalanced electromagnetic torque giving rise to a noticeable deflection from zero is therefore small, and the balancing precision becomes correspondingly high. As the current strength that has to be carried to the suspended coil is increased, the difficulty of securing small torsional moment at the zero point increases likewise. If, however, the null dynamometer wins favor in the electrical engineering laboratory for centiampere measurements, it seems likely that improvements in design will make it similarly useful for ampere measurements.

The Coming Issues

THE scarcity of fuel during the past winter, the possible repetition of such a condition next winter and the recent order regarding the distribution of coal make it especially important that all companies depending on fuel for power generation should arrange to exchange ideas on the economical utilization of low-grade coals. Some light will be thrown on this subject by an article which we will present shortly outlining experiences in the Northwest with powdered coal. Another subject which is becoming of greater importance as electric service systems and generating units become larger is that of the phenomenon which takes place when sudden short circuits occur. Prof. N. S. Diamant will discuss this subject in an early issue, giving a thorough, critical and relatively simple explanation of the action that takes place. Efficiency in the meter department and how one company remodeled its system to carry increased loads are other subjects that will be discussed. A map of the United States showing the coal zones as prescribed by the Fuel Administration will be presented with the ELECTRICAL WORLD as a colored supplement in connection with the Fuel Administration's order.

Value of Flywheels in Woodworking

They Have Proved Especially Desirable in Plants Where Individual Motor Drives Are Installed—Permit Using Smaller Motors, Improve Load Factor, Power Factor and Efficiency, and Relieve Equipment of Stresses

BY DAVID R. SHEARER

OWING to the fluctuations in load obtained with certain kinds of woodworking machinery, it has frequently been the practice to over-motor the machines in order to carry the peak loads. As a result the load factor, the power factor and the over-all motor efficiency have been detrimentally affected and more than the necessary outlay of money has had to be invested.

In several instances the writer has found that the average load on a given woodworking machine is only 50 per cent of the installed motor capacity and that some load peaks run as high as 100 per cent above the motor rating. In other words, some peaks occur which are four times the average load.

If the first cost of the motors were the only factor to be considered, much larger motors than are demanded by the machines might not be so objectionable; but the fact that any motor operating much below its rating will not operate at its maximum efficiency throws a different light on the subject. In the case of induction motors the power factor decreases with the load so that the system may be seriously disturbed if the motors are underloaded, especially if fed by a small local or isolated plant. The highest efficiency is usually obtained from an induction motor at full-load rating and the highest power factor at slight overloads. With one standard motor of the induction type the efficiency dropped 2 per cent from full load to half load, and the power factor dropped 12 per cent with the same decrease in load. Below half load the results are still more serious.

On account of the trouble experienced with some motor-driven woodworking machines in the past, some apprehension has arisen regarding the advantages of individual drive which should be dispelled, inasmuch as the trouble has generally been caused by improper application of the motor. So strong has been this objection that in some instances the individual drive has been taken out and group drive substituted so that the machine peaks could be carried by the overload capacity of a larger motor. This method of drive may be the correct thing in some cases, but is less desirable than the individual drive on account of the necessary shafting and belting with the attendant losses in efficiency. Furthermore, the group-drive motor may be subjected to concurrent peaks (Fig. 2) which may pull it out of step, thus shutting down the whole installation and causing serious delay.

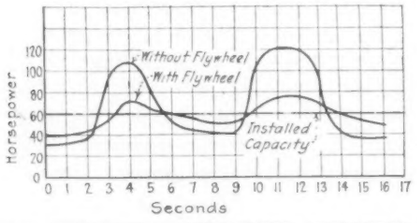


FIG. 1—LOAD CURVE OF A GANG-EDGER OPERATING ON GREEN LUMBER WITH AND WITHOUT A 1500-LB. (680-KG.) FLYWHEEL

The motor driving this machine is rated at 60 hp. and is directly connected to operate at a speed of 1800 r.p.m. on 440-volt, three-phase energy supplied by an isolated plant. The operating conditions were practically the same in both tests so that the value of the flywheel can be readily observed. Without the flywheel the demand increased above the maximum capacity of the motor for an instant. It caused excessive heating and sometimes stalled the machine. After the flywheel was attached the motor was operated at a lower temperature and never stalled during periods of heavier cutting.

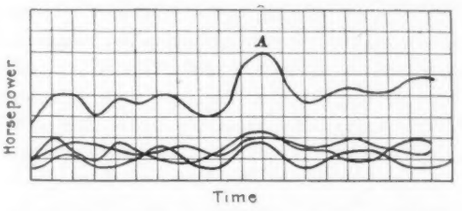


FIG. 2—INDIVIDUAL POWER-DEMAND CURVES OF THREE MOTORS WITH THE GROUP DEMAND PLOTTED ABOVE

None of these machines was equipped with a flywheel. The curves show that a concurrent group peak is possible which may require over-motoring of the group when flywheels are not used. In the plant at which these tests were conducted a total plant concurrent peak occurred on an average twice in ten hours.

The simplest and cheapest way to obviate pronounced peaks is to install individual flywheels on the motor shafts of each machine and retain the advantages of the individual drive. With this arrangement the loads can be carried by motors considerably lower in rating than would be required if flywheels were not used, and in addition the motors will operate more nearly at normal load. Of course, the flywheel must be especially designed for each machine as the operating characteristics vary considerably.

The duration of the cut and the period during which the machine is running idle are the principal factors which should determine the flywheel effect necessary. As an example, the duration of a trimmer cut is very short, while the idle period is slightly longer. A slasher cut is similar to that of a trimmer, but considerably more power may be required when a butt slab is being cut. A gang-edger cut is considerably longer than either of the foregoing operations. A short interval exists between cuts which must be taken into consideration in the design of the flywheel and in deciding upon the size of driving motor to install.

Sometimes it is convenient to test the instantaneous power demands on the machine while operating it from a motor somewhat larger than is necessary. From these tests the average load and maximum peaks can be determined. If the test results are plotted as curves, it is comparatively easy to decide how many foot-pounds must be added to the motor power during peaks by a flywheel to bring the power demand on the motor down to a desirable value. During the period when the machine is not cutting the motor stores energy in the flywheel, which can later be used while the tool is cutting.

Another factor to consider when using flywheels is

the rotor resistance of the driving motor when it is of the three-phase induction type. As the rotor resistance is increased the slip will increase, allowing a greater reduction of speed under heavy load and thus permitting the flywheel to give up some of its stored energy. If the load surges are frequent and pronounced, this characteristic of the motor tends to minimize the line disturbances, but if the peaks are of long duration a high-resistance rotor will allow the speed of the machine to drop too low for the proper action of the cutting knives or saws.

MACHINES ON WHICH FLYWHEELS ARE MOST DESIRABLE

The woodworking machines on which it is most necessary and economical to install flywheels, when operated by individual motor drive, include circular rip and cut-off saws, edgers, trimmers, slashers, timber trimmers, some types of planers and flooring machines, "hogs," and in general any machine which has periodic loads and periods of non-production. Flywheels are not of much advantage on band saws, because these machines usually have sufficient flywheel effect in the band wheels which carry the saw.

As the friction load of any woodworking machine is practically constant, it is advisable to determine this load first, then the average power necessary to do the actual cutting. These two factors will determine the motor size if a flywheel is used to reduce the peaks to a value which can be handled by the overload capacity of the motor.

As a result of the tests indicated by Figs. 1 and 2 and others made upon different woodworking machines the writer has come to the conclusion that better results would be secured with individual drive by the more general use of suitably designed flywheels. The necessary generating plant capacity would be decreased, the size of the individual motors could be reduced, the load factor would be improved, the efficiency increased and the power factor raised. Furthermore, flywheels will relieve the motors and starters from excessive stresses occasioned by the pronounced surges of power demand.

Predicting Load on Residence Circuits

Data Which Assist in Making Intelligent Estimates of Future Requirements on Feeders Carrying Residence and Store Lighting Loads, Including Table Showing Ratio of Each Month's Load to Load of Remaining Months

BY P. O. REYNEAU
Distribution Engineer Detroit Edison Company*

IF THE demands for electric service which are made each year are to be met economically, they must be anticipated far enough in advance to enable provisions to be made for serving them when it is most economical to do so. About the only way to make intelligent estimates of future requirements is to couple an analysis of past rates of load increase with a far-sighted judgment which will take into account the effect of future conditions on the past rate of growth.

Predicting the load on circuits carrying a load consisting of residence and store lighting is usually simplified by the fact that the growth is relatively constant and that the other factors that come in to modify the estimates can be analyzed and allowance can be made for them.

In the following it will be shown how an analysis of the conditions causing the increase has been attempted for a number of single-phase circuits fed by 200,000-circ. mil. underground cables and No. 0 or No. 0000 overhead wires.

The data available for such a study consist of a set of curves, one for each circuit, showing the monthly maxima over a period from September, 1914, to the present time. These curves are not all of the same outline, yet there are certain characteristics appertaining to all which could be expressed in one curve to be considered typical. A typical curve would serve as a fairly firm foundation on which to base estimates for the future.

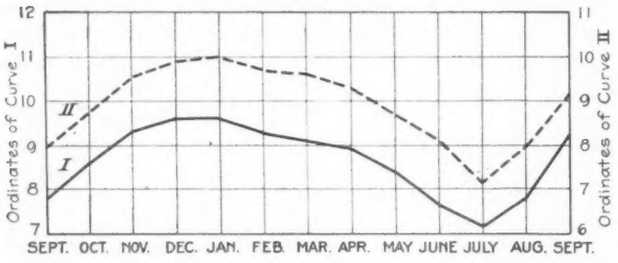
The changes in circuit loads shown by an inspection of the monthly maxima are caused by a number of easily defined factors. The first is a seasonal condition due to the change in the length of days and the result of cold weather keeping people indoors; the second is an increase in the use of electricity by each customer caused by the greater appreciation of the uses of electrical energy in the home; the third is due to increase of population within the boundaries of each circuit; the fourth is due to the embracing of new territory by the circuit or to the loss of old caused by switching of load on account of overload or other operating necessities.

The first two factors are constants in their own particular sense—that is to say, the rate of increase due to these factors is a fairly constant value—and the third is partly so, for it may be subdivided into two, the factor of normal increase in population and that of abnormal increase. Normal increase will be encountered in practically every section of the city, abnormal only in sections not yet closely built up and to which people are attracted by real estate activity or the circumstances of industrial development. The fourth factor is a result of the preceding three and must be considered as indefinite, as it appears both for and against increases of load. It is a factor, however, for which correction may be made, since its use lies within the control of the operating company.

The ordinates of curve I are proportionate to the sums of the maxima monthly loads on the circuits averaged over three years. It was considered that the indeterminate factor of changes in territory would not affect the curve, inasmuch as they appeared in different circuits at different times of the year and their effect would be reduced to a comparatively small value with

*Assisted by Frank R. Innes.

an average equal effect on all the ordinates of the curve, in view of the long period of time covered. This assumption is borne out by the comparison of curve I with curve II. This last curve covers a period of only one year—September, 1916, to September, 1917—and was corrected for changes in territory. The corrections were made by deducting from the totals of each month the amount representing the load in the same territory appearing in two circuits in the same month. This condition of duplication of load is due to the fact that when a change in boundary for the relief of any



TYPICAL CURVES TO SHOW INCREASE IN MONTHLY MAXIMA

circuit is made the load on the section cut off appears in the maxima of both the circuits relieved and relieving. It would be possible naturally to take a well-built-up district including several circuits and establish a curve showing the growth per year of that nature of load, leaving the new circuits with abnormal growth for a special study. This refinement is hardly necessary, as the percentage of growth would not be much diminished. In the method used here there is introduced a small factor of safety.

In order to make the curve more easily applicable it has been reduced to a table of percentages in which the load for each month in the year appears as a percentage of every other month in the year. It is possible by the use of this table to take the load on any circuit for any given month and predict on that circuit the load for any future date, always considering that the boundaries of the circuit remain unchanged and that there are no particular conditions in that circuit which will cause an abnormal increase or decrease in the load.

It is not the intention that this curve, or the percentage table developed from it, shall figure as an absolute method for estimating future loads, but merely as a basis on which are to be imposed the particular conditions obtaining for each territory under consideration. The table contains no allowances for abnormal conditions, and the results derived from it may in some cases have to be considerably modified by such conditions as changing of circuit boundaries, rapid increase in rate of settlement and others. However, the table is sufficiently accurate to serve as a basis in estimates on the necessity for future work, unless the speed of growth of the city is greatly diminished or increased from the average rate maintained for the past three years.

The table gives the load on any circuit for any month in terms of any other month, and by correct selection of factors it is possible to predict with reasonable accuracy the future maximum load in amperes on any circuit if a present or previous reading on that circuit is given. For example, the November, 1917, load on a circuit is 223 amp., and it is desired to estimate its load for January, 1919. Taking the November load as 1 in the table, the load for the following September is 0.993 of the November load; then taking this September load as 1, the load for the following January is 1.23 of this calculated September load. In this case, therefore, the January, 1919, maximum load of this circuit will be $223 \times 0.993 \times 1.23 = 272$ amp. This table should be read downward for predicting future load, upward if past loads are to be determined.

Having established a table for predicting the load on any circuit, this table is used, corrected as explained above for factors beyond its scope, for laying out new circuits for the coming year. It means providing substation capacity, switches, cable and overhead feeders and the primary wire necessary for the changes in boundaries. A map is made showing the circuit outline and indicating the estimated load for the coming year for each circuit. It is used for determining the best location for the new circuits. A careful examination is made of the circuit boundaries with a view to finding the best places for tying in or separating the primaries of the old circuits and of the new circuits to be installed. Up-to-date maps of the distribution system are of great value in this work. After analysis it is usually found that there are, owing to street or alley conditions, boulevards, railroads and other physical conditions, natural boundary lines, and that the best economy will be reached by using them. It is also advisable to look ahead as much as possible beyond the one year increase and so handle the work that new boundaries can be easily established later. The table is also used to determine at what time it is possible to do the necessary temporary transferring of territory that will ultimately permit the establishment of the boundaries as planned for the time of peak load.

Perhaps the most important factor from the economical standpoint is the proper loading of each circuit feeder. Residence and store lighting load has a very low load factor and reaches its maximum for only a few weeks every year. It is therefore very important to limit as much as possible the investment required

RATIO OF EACH MONTH'S LOAD TO THE TOTAL LOAD FOR THE REMAINING MONTHS OF THE YEAR

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Sept.	1	0.892	0.825	0.815	0.812	0.831	0.836	0.862	0.911	1.003	1.098	0.988	0.831
Oct.	1.113	1	0.913	0.907	0.904	0.925	0.931	0.958	1.013	1.117	1.223	1.100	0.925
Nov.	1.210	1.087	1	0.986	0.983	1.006	1.012	1.042	1.102	1.216	1.330	1.196	1.006
Dec.	1.226	1.101	1.012	1	0.996	1.018	1.026	1.057	1.117	1.231	1.348	1.212	1.018
Jan.	1.230	1.105	1.015	1.003	1	1.022	1.029	1.061	1.121	1.236	1.352	1.216	1.022
Feb.	1.203	1.081	0.993	0.980	0.977	1	1.006	1.037	1.096	1.208	1.332	1.188	1
Mar.	1.195	1.073	0.986	0.974	0.972	0.993	1	1.030	1.088	1.200	1.312	1.182	0.993
Apr.	1.159	1.041	0.957	0.945	0.943	0.964	0.970	1	1.056	1.163	1.273	1.146	0.964
May	1.096	0.986	0.906	0.895	0.892	0.912	0.918	0.946	1	1.100	1.204	1.083	0.912
June	0.995	0.894	0.822	0.812	0.809	0.827	0.833	0.858	0.906	1	1.093	0.984	0.827
July	0.910	0.818	0.752	0.742	0.739	0.756	0.761	0.784	0.829	0.914	1	0.900	0.756
Aug.	1.010	0.908	0.835	0.825	0.822	0.841	0.846	0.872	0.922	1.014	1.110	1	0.841
Sept.	1.203	1.081	0.993	0.980	0.977	1	1.006	1.037	1.096	1.208	1.322	1.188	1

for its handling. Having established an average maximum load allowance on the underground cable and made provisions as desired for maintaining standard quality and continuity of service, the table above described and the analysis of circuit conditions are a means of providing for the coming year an adequate load on every circuit so that the equipment will work as near as possible to maximum efficiency. The matter of quality and continuity of service is beyond the scope of this paper. It can be briefly said that the reliability

of the service all along the line from the power house to the service taps of the individual consumer, and especially the reliability of the underground cable and of the overhead feeder, will determine the required throw-over facilities that will give satisfactory service.

It is of interest to note that the maximum average load in the last three years has increased 27 per cent, the total number of circuits increasing 75 per cent. The allowable average maximum has not been reached yet, but it is hoped that it may be reached in the future. It can be truly said that such condition would represent the highest efficiency obtainable under the given condition.

PROTECTING INTERESTS OF OWNERS OF SMALL COMPANY

Turners Falls Power & Electric Company Makes Contract for Purchase of Amherst Substation with Provisions Carefully Prepared

TO PROTECT the interests of stockholders in the Amherst (Mass.) Gas Company, which owned a 1525-kva. substation supplied with energy by the Turners Falls Power & Electric Company, an interesting procedure recently took place in connection with a transfer of the substation to the power company. Philip Cabot of Boston is president of both companies, but the stockholders are not the same, though the two companies have the same management.

With the growth of the Turners Falls system of hydroelectric supply in the central Connecticut Valley, it appeared desirable to the management that the substation should be sold to the larger company and a new contract executed for electrical supply. Instead of taking action along this line, the management called a special meeting of stockholders to consider the advisability of selling the substation to the Turners Falls company, and a committee was appointed to investigate and report upon the matter.

The committee reported unanimously in favor of the sale of the substation at its book value (about $145,000, including three small tenements for operators), pointing out that this price represents the total original cost of the plant and equipment without deduction for depreciation or obsolescence. The committee held that the gain in the financial strength of the gas company through the cancellation of approximately $145,000 floating debt in this way would result ultimately in a far greater benefit to the stockholders than the privilege of receiving in the future stock rights of problematical value.

Under the gas company ownership of the substation, energy was received from the power company at the wall of the substation. Under the new ownership the plan is for the gas company to receive energy at the substation wall, involving a new contract and affording a good opportunity for the gas company to require the Turners Falls company to adjust the price for the electrical energy sold to it on a more equitable basis when compared with prices paid by other public lighting companies and municipal plants.

It was pointed out that if the Turners Falls company thus obtained a practically modern substation at a price materially below the present cost of building, it ought at the same time to be willing to place the gas company in as favorable a position with regard to rates as it does other central stations of equal size in the Connecticut Valley.

The report stated that unless a satisfactory contract for the delivery of electrical energy under the new conditions could be obtained it might be advisable to hold the substation and to continue to operate under the previous terms. The committee recommended that the life of the contract should be at least fifteen years; that the basic price for energy should be not over 1.25 cents as compared with 1.5 cents per kilowatt-hour; that any coal clause should operate only between July 1 and Dec. 1 of each year, should be drafted upon a basic price for coal of not more than $4.50 per ton and should contain a provision that in no event should the price of electrical energy delivered exceed 1.5 cents, and that so far as possible payments, including settlements on account of coal charges, should be made monthly. The method of determining the true cost of coal from time to time, the committee felt, should be left to the management.

A new contract was executed between the companies as recommended, including the transfer of the substation as a part of the proceedings incidental to the investigation. An estimate was prepared of the cost of reproducing the substation under 1917 prices. This totaled $160,300 (about $105 per kva.) and is detailed in the tabulation printed here, as prepared by the engineers of the Turners Falls company.

COST OF REPRODUCING AMHERST SUBSTATION

TRANSFORMERS, REGULATORS AND LIGHTNING ARRESTERS		
Three 225-kva., 66,000/2300-volt self-cooled transformers	$3,500	
Three 250-kva., 66,000/2300-volt self-cooled transformers	5,000	
Two 50-kva., 2300/4400-volt self-cooled transformers	1,150	
Four 50-amp., 2300-volt feeder regulators	4,500	
Three 25-kw. street-lighting transformers	1,200	
Thirteen lightning arresters	13,500	
		$28,850
SWITCHBOARD AND SWITCHING EQUIPMENT		
Eight 66,000-volt, three-phase oil switches	$20,000	
Eighteen 66,000-volt, three-phase disconnecting switches	4,500	
Six 66,000-volt potential transformers	5,400	
Six 66,000-volt current transformers	1,800	
Fourteen-panel, 2300-volt switchboard	9,800	
Station service switchboard	775	
		42,275
STATION ACCESSORIES		
Including storage battery, oil filters, oil pumps, oil piping, battery-charging set, telephone booths, chain hoists, stockroom equipment, garage fittings, plumbing and heating equipment		6,000
MATERIAL FOR WIRING		
All wire and cable and conduits, twenty-one 66,000-volt bushings, low-voltage wall bushings		9,400
LABOR		
Labor to install all equipment and wiring material		5,900
OTHER ITEMS		
Land, 10.23 acres		5,115
Building, 179,000 cu. ft.		55,000
Engineering		7,760
Total		$160,300

The Effect of Daylight Saving on Load

Data and Curves Showing How the Daylight-Saving Law Affects Typical Central Stations in the Middle West—No Large Coal Saving—Creation of a New Evening Valley

IT IS difficult at this time to predict accurately what ultimate effect the daylight-saving law will have on central stations. Experience will be necessary to show exactly what will happen in properties of different classes. Enough data have been gathered, however, to indicate the trend of events in some properties and the probable consequences which must follow the shift in the clocks. In the collection and analysis of these data as much care as possible has been exercised to choose only fairly typical instances and those free from influences other than the advance in standard time. It should also be pointed out that the curves and data herewith were taken only from public utilities in the Middle West, where Eastern time had not been adopted prior to April 1.

Some Interesting Deductions

Among the facts apparent and the deductions drawn as the result of the investigation in these properties are:

That the plan as it now is will not effect any great saving in coal.

That a new valley has been created in the average load curve between the hours of 5 p. m. and 8 p. m.

That the average reduction in output in kilowatt-hours due to the daylight saving is around 5 per cent.

That the reduction in gross revenue will be larger proportionately than the reduction in output on account of the fact that the reduction comes mostly out of the "high-rate" business.

That while the change may for the present, in some instances, better the daily load factor, it will no doubt reduce the annual load factor, thus increasing the ratio of investment to income.

That the central stations are accepting the situation in the spirit of patriotism, but with full realization that relief from the general situation of increasing costs and stationary incomes must be granted.

The ten load curves herewith, received from plants in the territory reaching from Ohio to Iowa and from Kentucky to Minnesota, all bring out clearly the creation of the new evening valley. Of course, the amount of electric power and railway load carried by the individual plants determines in a general way how great the depth of this valley is, for it is created by the curtailment of lighting almost entirely.

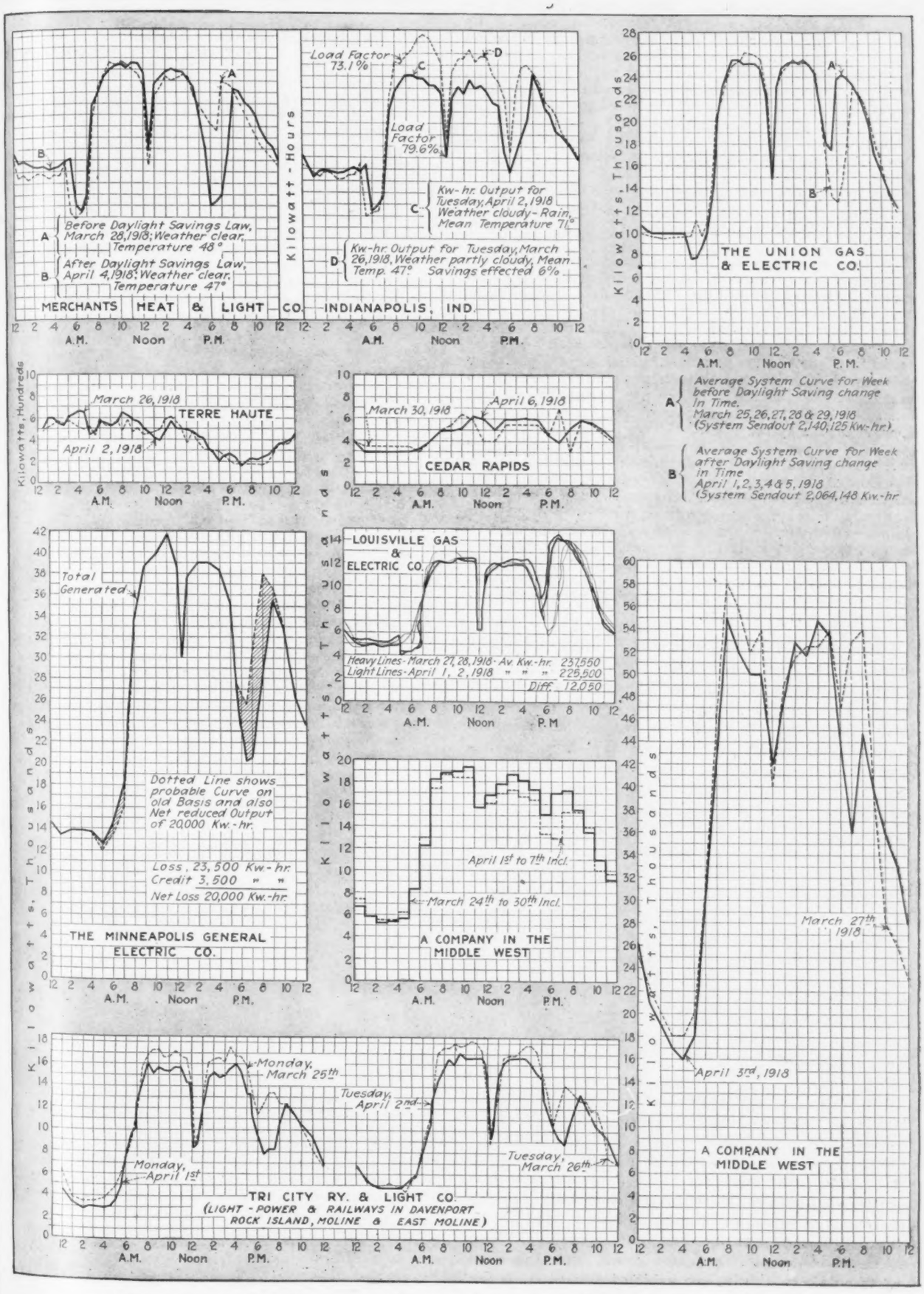
Moreover, these curves are of interest in the fuel-saving argument. In the first place, the central stations burn only a small percentage of the nation's fuel. They burn it with more than ordinary efficiency. Now, the reduction in load which the daylight bill produces comes at such a time and in such a way that good operation will probably dictate carrying over the new valley many boilers ready to steam. So while a few kilowatt-hours less will be produced, the reduction in coal burned will be very small.

Judging from the general trend of the curves, it is reasonable to expect that the small-town utility will lose much more than the average large town property. The data on outputs show that in some places the reduction in kilowatt-hours per day was as low as 3.5 per cent, but this could not be accepted at its face value since the daily addition of large power loads to the plants in question must undoubtedly have operated to offset the real decreases. The figure of 5 per cent is selected as the nearest weighted average obtainable. The figures in many cases are higher, especially in non-industrial cities where additional war business is not being added daily.

There appears to be no dissent from the opinion that gross revenue will be reduced by a greater percentage than the output. Those who have the temerity to estimate this place it at around 10 per cent to 15 per cent on the average.

Where it has been possible to secure data on daily load factors, the figures have shown as much as 6 per cent increase for an individual day. Over longer periods the average increase in load factor shown has not been more than 2 per cent or 3 per cent. In fact, it is possible that in some instances worse daily load factors may be obtained under the new time than under the old. This matter of load factors in connection with daylight saving seems to be one of vital interest to central stations, for linked up with it is the question of extending the daylight saving plan to twelve months in the year instead of only seven months as the present law provides. On this subject one Middle Western central-station manager has written:

> From the standpoint of conservation of fuel I do not believe that the present plan will accomplish a great deal, but it undoubtedly would if the plan covered the entire year. The plan as decided on will reduce the annual load factor and consequently increase operating and investment cost per unit.
>
> If the plan were carried throughout the year, there would be an increase in the annual load factor, with a consequent reduction in both operating and fixed charges per unit, but more especially there would be a substantial reduction in the output, with a consequent conservation of fuel and reduction in the peak load, owing to the greater diversity obtained. This reduction in the peak load would release a great deal of equipment and enable many central stations to take on additional power business, which is extremely desirable, and would also conserve capital, labor and material by making it unnecessary to add to existing equipment to the same extent that would be necessary under the present plan.
>
> The peaks would undoubtedly come in the morning in most latitudes, if the plan extends throughout the year, but would not be of the magnitude of the evening peak under the present plan.
>
> During the months of November to January inclusive there is an overlapping of the lighting, power and railway loads, due to the fact that the lighting load comes on earlier than during the rest of the year. This makes it necessary for the central stations to provide a large excess of plant capacity to meet this peak load, which is only on about an hour and a half a day during these months. In order to meet this peak load banked fires are carried for twenty-two and one-half hours a day, and this represents an absolute waste of coal. All central-station companies are unquestionably willing to go the limit in carrying out any policies


A
Before Daylight Savings Law, March 28, 1918; Weather clear, Temperature 48°
B
After Daylight Savings Law, April 4, 1918; Weather clear, Temperature 47°
MERCHANTS HEAT & LIGHT CO. INDIANAPOLIS, IND.
Kilowatt-Hours
Load Factor 73.1%
Load Factor 79.6%
C
Kw-hr. Output for Tuesday, April 2, 1918 Weather cloudy-Rain, Mean Temperature 71°
D
Kw-hr. Output for Tuesday, March 26, 1918, Weather partly cloudy, Mean Temp. 47° Savings effected 6%
A.M. Noon P.M.
Kilowatts, Thousands
THE UNION GAS & ELECTRIC CO.
A
Average System Curve for Week before Daylight Saving change in Time. March 25, 26, 27, 28 & 29, 1918 (System Sendout 2,140,125 Kw-hr.)
B
Average System Curve for Week after Daylight Saving change in Time April 1, 2, 3, 4 & 5, 1918 (System Sendout 2,064,148 Kw-hr.)
Kilowatts, Hundreds
March 26, 1918
April 2, 1918
TERRE HAUTE
March 30, 1918
April 6, 1918
CEDAR RAPIDS
Total Generated
Dotted Line shows probable Curve on old Basis and also Net reduced Output of 20,000 Kw.-hr.
Loss, 23,500 Kw.-hr.
Credit 3,500 " "
Net Loss 20,000 Kw.-hr.
THE MINNEAPOLIS GENERAL ELECTRIC CO.
LOUISVILLE GAS & ELECTRIC CO.
Heavy Lines-March 27, 28, 1918-Av. Kw.-hr. 237,550
Light Lines-April 1, 2, 1918 " " " 225,500
Diff. 12,050
April 1st to 7th Incl.
March 24th to 30th Incl.
A COMPANY IN THE MIDDLE WEST
March 27th 1918
April 3rd, 1918
A COMPANY IN THE MIDDLE WEST
Monday, March 25th
Tuesday, April 2nd
Monday, April 1st
Tuesday, March 26th
TRI CITY RY. & LIGHT CO.
(LIGHT-POWER & RAILWAYS IN DAVENPORT ROCK ISLAND, MOLINE & EAST MOLINE)

EFFECT OF DAYLIGHT-SAVING LAW IN MIDDLE WEST CENTRAL STATIONS

which the administration may think necessary to the winning of the war, but, on the other hand, the federal, state and municipal authorities must take cognizance of orders which are increasing the cost to the central station and see to it that not only central stations but public utilities of all kinds receive such increases in rates as will enable them to keep pace with the growth of the communities, and this can only be done if they are permitted to increase rates to a point which will keep them in relatively as favorable a position in respect to earnings as during pre-war years.

The following from another central-station executive is of interest as showing the reality of the need for relief in the way of increased rates. He said:

I think that while this is a real economy and results in a saving of money to the people and a little fuel to the companies, it does not reduce the companies' cost to anything like the extent that it reduces their revenue, as the whole of their organizations must be kept up and the only saving is in fuel. In other words, this will operate as an additional hardship to the electric companies, and it affords one more good reason why the public authorities should take steps to ameliorate the conditions of electric companies brought about by rapidly advancing costs on the one side and stationary revenue on the other.

It must be remembered that while the decrease in kilowatt-hour output is only 5 per cent or 6 per cent, the decrease in revenue is very much larger. The decrease does not come off the power load, but comes almost entirely off the residence lighting load, which with all companies is the highest-priced energy that is sold. A considerable part of the cost of serving residences is what is called "stand-by" costs. These are not diminished at all, nor is the cost of standing ready to answer complaints. In fact, there is no saving except the saving in fuel, and this is very small compared to the loss in revenue.

Should the law not be amended to move the clocks ahead all the year, that new valley will probably be made the target of many a new-business manager. Ways and means of filling it will be the topic of the day. That being the case, it is reasonable to expect intensive solicitation of business that comes on between 5 p. m. and 8 p. m. Electric range loads, electric sign loads, electric truck loads and such business will become increasingly popular with the central station.

That such loads can be secured to fill a part of the valley is one bright gleam on the horizon. What may probably be another is to be found in the experience of a French central station. It was one of the largest concerns generating energy for sale in Paris. Before the daylight plan was adopted it was furnishing some 31,000 kw. per day. Within a day or two after the change this figure fell to 29,000 kw. When the normal daytime distribution of hours was restored in October the same plant was running at a nightly load of 35,000 kw., which within a few days of the change jumped to 53,000 kw.

This might be taken to indicate that the change back to the old standard time, which will take place next October, will be of greater significance to the electric companies than was the change to the new schedule in the spring. Authorities on lighting believe that this can be accounted for by the same theory that accounts for the use of lamps of larger and larger sizes by the general public as lighting has become more efficient. In this development it has been found that it is easy for the public to acquire the habit of using more light but that it is difficult for it to go back to lower standards of illumination when once it has been educated to higher intensities.

A LITTLE PLAIN TALK ON WATER POWERS

[From an address by Senator Jones of Washington in the United States Senate on April 27]

Why does not Congress enact legislation which will make possible the development of our water powers? Why is this not done when we have it on the high authority of the Chief Executive of the land that next to matters relating strictly to the immediate conduct of the war it is the most important public business before Congress?

For ten long years restrictive federal water-power laws have prevented the utilization of the energy contained in our descending waters. This mighty resource has been allowed to waste while enormous quantities of coal and oil have been taken from the earth and used up to meet the ever-increasing demand for electric energy, which during the last decade has increased sixfold.

The development of water powers is pioneer work of a hazardous nature, subject to many risks and uncertainties, and, under regulation of rates by public authorities, the hydroelectric business is and must be conducted upon a close margin of profit. Capital, therefore, will not invest nor men put in their time in hydroelectric development except upon a basis which, so far as government requirements are concerned, will at least not jeopardize the investment or prevent a fair return thereon. The time has come when the country needs the force and energy contained in its wasting water powers to supplement its man power, and the penalty of delay is enforced by fate against the unready.

Let us put the blame where it belongs. The fault is with Congress and with Congress alone. It is the lawmaking body. It cannot escape that responsibility. The controversy in the country over the character of legislation under which water powers can be developed has been reflected in Congress, and thus far we have been unable to get together. Each extreme has held fast to its own view and our water powers have been idle and wasting.

If Congress had acted five years ago and passed suitable legislation, millions and millions of water power would have been utilized that are still going to waste, and the successful carrying on of the war would have been enormously aided, fuel and labor shortage greatly lessened and the transportation problem rendered much less acute.

Failure of Congress to pass a workable water-power law at this session will be nothing short of crime and disloyalty to the dire necessity of our country. Germany and Austria have developed 90 per cent of their water powers and we but 10 per cent of ours.

Senators, the development of our water power would make the United States impregnable in time of war, commercially dominant in time of peace—impregnable in time of war through furnishing the energy required for production of explosives and munitions, for operation of railroads, and in a thousand ways in the conduct of hostilities, thus releasing our man power for the army and navy; commercially dominant in time of peace through furnishing energy for industrial activities, electrical and electrochemical processes, for transportation, for agriculture, and for the innumerable things into which the use of power enters in the daily life of our citizens. The safety, the welfare, the prosperity and the progress of the nation demand and require the prompt enactment of water-power laws in which protection of the public interest shall be co-ordinated with fairness toward capital. The House should pass a bill soon. If amendatory of ours, it should be sent to Congress and our differences harmonized.

Control of Station Auxiliaries

Placing Contactors Near Transformers Saves Copper—Emergency-Supply Circuit Equipped with Instruments to Serve as Test Circuit—Description of Other Methods Used to Good Advantage by Chicago Company

FEATURES of recent additions to the Northwest station of the Commonwealth Edison Company were brought out in last week's issue of the ELECTRICAL WORLD, particular attention being called to the excitation system adopted and the relay and protective devices employed. In this article, which concludes the account, it will be pointed out how the auxiliary motors are controlled, how copper has been saved in the circuits feeding them, and how an emergency-supply circuit is provided which may also be used for testing the performance of the auxiliaries.

POWER SUPPLY FOR THE AUXILIARIES AND THEIR CONTROL

Power for the motor-driven auxiliaries used in connection with the first three units installed was supplied at 220 volts, 60 cycles, from two 750-kva., 12,000/230-volt oil-cooled transformers. The circulating pumps were steam-driven. When the last three units were added all circulating pumps were provided with motor drive since the steam units already operating supply sufficient exhaust steam to meet the requirements of the entire station. All of the miscellaneous small auxiliaries of the plant have been added to the original 220-volt system. A 440-volt system has been installed to feed the motors of the circulating pumps and the economizer fans and the external blower fans on units Nos. 5 and 6. The possibility of saving copper dictated this change of potential.

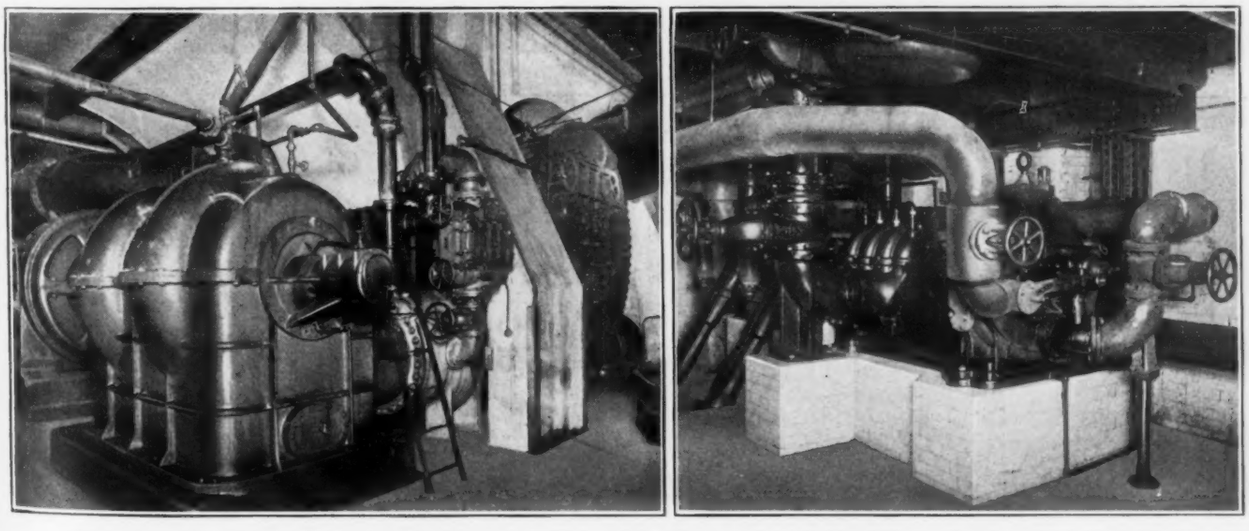
To supply 440-volt power three oil-insulated, water-cooled, 2000-kva., 12,000/460-250-volt transformers were installed. The 12,000-volt supply for each transformer is taken from the switch house in the same manner as that for the transmission lines.

Polyphase watt-hour meters record the energy consumption on these three lines. The transformers are equipped with reverse power relays to permit parallel operation and with high and low voltage protection. They feed a 250-volt and a 460-volt bus, the lower potential being used for starting and the higher for running. The power transformers and the switchboards are installed in the transformer house about 300 ft. (91.4-m.) from some of the motors served.

Push-button control is employed for starting all of the motors on the 440-volt system. Industrial-type control was selected because the equipment is operated mostly by a class of labor which can hardly be intrusted with a 440-volt manual-control switching equipment. Moreover, it is less expensive.

The general scheme of control is shown in Fig. 3. The circuit for each 150-hp. economizer motor, of which there are five per unit, is connected with the 250-volt starting bus and 460-volt running bus through two three-pole contactors remote-controlled from push-button stations near the driving motor. Pushing the starting button automatically actuates the three-pole starting and running contactors in turn. Placing the contactors near the transformers, which, as has been said, are quite remote from the motors, has eliminated the necessity for one set of heavy three-conductor No. 4/0 cables per motor which otherwise would have been required for starting service.

An equally interesting plan has been worked out in connection with the emergency service for these motors. As may be seen from the diagram, one 440-volt emergency circuit serves all fifteen economizer motors. Two sets of contactors are provided at the switchboard, and at each motor station the emergency circuit is connected to the bottom clips of a double-throw selector switch, the normal service to the motor being connected to this upper clip. Auxiliary contacts on this switch automatically transfer the control from the normal to



FIGS. 1 AND 2—MOTOR-DRIVEN CIRCULATING PUMP AND TURBINE-DRIVEN CONDENSATE AND HYDRAULIC AIR PUMP

the emergency circuit when the switch is thrown. The throw-over to emergency is under lock and key, so that only the authorized attendants can have access thereto. The emergency circuit is the only economizer motor circuit in which instrument transformers are connected, it being the idea to use it exclusively if tests are being made.

The cables serving the three 650-hp. circulating pumps on units Nos. 4, 5 and 6 and the two 300-hp. blowers on units Nos. 5 and 6 consist of two three-conductor 500,000-circ. mil lead-covered cable. These are connected to the 460-volt bus through knife switches equipped with fuses. At the starting contactor panel the circuits are connected to double-throw selector switches. The motors, which are of the slip-ring type, are started by push-button control, industrial-type contactors being used to cut resistance out of the rotor circuit instead of employing the 250-volt starting bus. This is done to eliminate heavy rush of current in starting these motors. An emergency feed which is separate from that used for the economizer motors is provided for the motors. It is connected to the selector switches at the contactor panels and is equipped with instrument transformers for testing purposes.

All of the contactors on the 440-volt system are operated by 120-volt direct-current solenoids. Direct current was selected because the storage batteries employed assure more reliable service than any other source of supply which could be provided. Energy for these solenoids is taken from the station operating bus. The contactors for the various motors of each unit, Nos. 4, 5 and 6, are fed from a separate direct-current bus to localize trouble in emergencies. This grouping of contactors is shown in Fig. 3. Each individual direct-current bus is connected with the station operating bus by means of a single-pole solenoid-operated switch which is held closed by a two-element low-voltage relay. This consists of an alternating-current instantaneous relay of the circuit-closing type which closes the circuit through a direct-current time-element relay of the circuit-opening type. The two-element relay operates if the potential on the 460-volt bus drops as low as 230 volts for ten seconds.

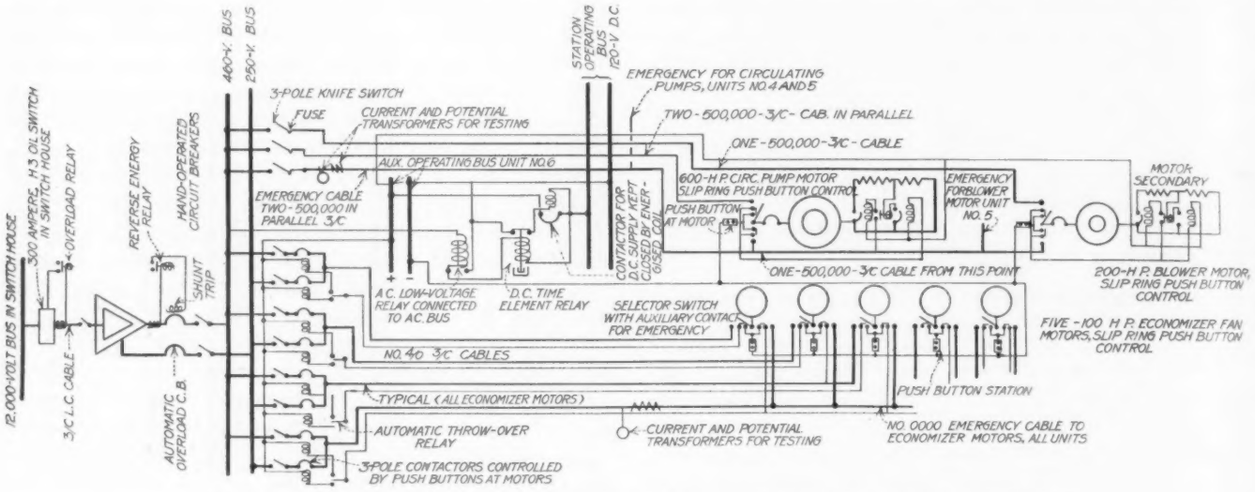
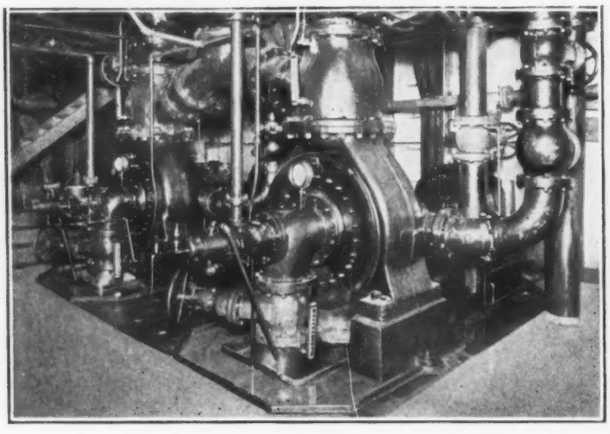
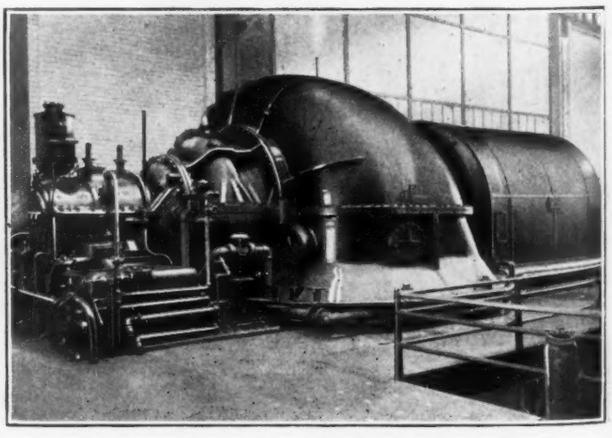

12,000-VOLT BUS IN SWITCH HOUSE
300 AMPERE, H.3 OIL SWITCH IN SWITCH HOUSE
OVERLOAD RELAY
3/C L.C. CABLE
REVERSE ENERGY RELAY
HAND-OPERATED CIRCUIT BREAKERS
SHUNT TRIP
AUTOMATIC O.L. C.B.
460-V. BUS
250-V. BUS
3-POLE KNIFE SWITCH
FUSE
CURRENT AND POTENTIAL TRANSFORMERS FOR TESTING
AUX. OPERATING BUS UNIT NO. 6
EMERGENCY CABLE TWO-500,000 IN PARALLEL 3/C
A.C. LOW-VOLTAGE RELAY CONNECTED TO A.C. BUS
D.C. TIME ELEMENT RELAY
CONTACTOR FOR D.C. SUPPLY KEPT CLOSED BY ENERGIZED COIL
STATION OPERATING BUS 120-V. D.C.
EMERGENCY FOR CIRCULATING PUMPS, UNITS NO. 4 AND 5
TWO-500,000-3/C-CAB. IN PARALLEL
ONE-500,000-3/C-CABLE
600-H.P. CIRC. PUMP MOTOR SLIP RING PUSH BUTTON CONTROL
PUSH BUTTON AT MOTOR
EMERGENCY FOR BLOWER MOTOR UNIT NO. 5
MOTOR SECONDARY
ONE-500,000-3/C CABLE FROM THIS POINT
200-H.P. BLOWER MOTOR, SLIP RING PUSH BUTTON CONTROL
SELECTOR SWITCH WITH AUXILIARY CONTACTS FOR EMERGENCY
FIVE-100 H.P. ECONOMIZER FAN MOTORS, SLIP RING PUSH BUTTON CONTROL
NO. 4/0 3/C CABLES
TYPICAL (ALL ECONOMIZER MOTORS)
PUSH BUTTON STATION
AUTOMATIC THROW-OVER RELAY
CURRENT AND POTENTIAL TRANSFORMERS FOR TESTING
NO. 0000 EMERGENCY CABLE TO ECONOMIZER MOTORS, ALL UNITS
3-POLE CONTACTORS CONTROLLED BY PUSH BUTTONS AT MOTORS

FIG. 3—METHOD OF CONTROLLING AUXILIARIES THAT INCREASES RELIABILITY OF SERVICE

Additional protection for the auxiliary equipment is provided by the installation of signal lamps near the push-buttons controlling all of the 440-volt motors. The lamps are fed from the 250-volt bus. The buttons are not to be operated unless the lamps are lighted, indicating that the starting bus is energized. This precaution has been taken to prevent the starting of motors on full potential.

The entire electrical design of the Northwest station was handled by the inside plant division of the engineering department of the company.





FIGS. 4 AND 5—COMBINED AIR AND CONDENSATE PUMPS SERVING 35,000-KW. TURBO-GENERATOR AT RIGHT

Value of Higher Steam Pressures

A Statement of the Yearly Saving Which Can Be Realized from Higher Steam Pressures, with Capitalized Value of This Saving for Various Loads, Coal Rates and Rates of Capitalization

BY J. T. FOSTER

Engineer Public Service Electric Company of New Jersey

DECREASED net profits due to the rapidly mounting cost of operation have forced the central-station industry to face a serious situation. While it is true that a measure of relief has been obtained by the granting of petitions for increased rates, the greater part of the difference between normal profits and present-day profits has to be made up by rigid economy. This condition is not limited by the duration of the war because there is always a greater or less degree of inflation which causes the high prices of material and labor to continue for some years after the actual conflict has ceased.

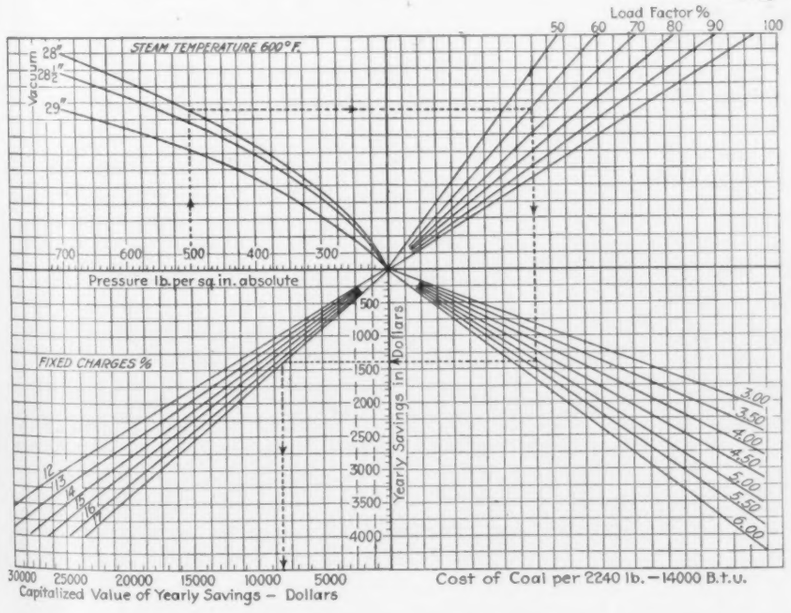
The need for practicing economy, however, is not a new experience for utility companies, as the whole development of the industry has been along the lines of more economical operation. Since the steam turbine first came into use the attention of operating and designing engineers has been directed to its improvement because the greatest heat loss by far occurs in this part of the power-plant equipment. Condensing apparatus was improved and superheat increased so as to operate on the most efficient part of the steam cycle, and in addition the mechanical features of the turbine were redesigned to make the actual machine show a performance as close as possible to that of the ideal turbine.

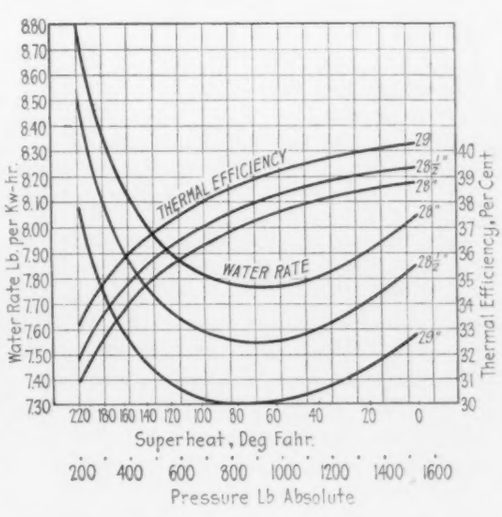
Probably the most profitable line of development was that of increasing the capacity of turbo-generators, as this resulted in a marked improvement in thermal efficiency and a consequent decrease in steam consumption. Recent developments, however, have led some engineers to believe that because of mechanical limitations the ratings of turbines will not increase much above those of the largest units now in use and that any further progress will necessarily involve increasing the steam pressure.

The installation at the Joliet plant of the Public Service Company of Northern Illinois of a 10,000-kw. turbine designed for 300-lb. (21 kg. per sq. cm.) steam pressure is an advance in this direction, and it is believed that water-rate tests on this unit will show a surprisingly low steam consumption for a turbine of this capacity.

It is probable that within the next five years operating pressures will be increased to 500 lb. or 600 lb. (226.8 kg. to 272.2 kg.), so it is interesting to calculate just what will be the probable effect on fuel cost under these conditions. Fig. 1, which is a curve* of theoretical Rankine-cycle water rates and thermal efficiencies, may be used to ascertain the money value of any change to higher pressures. Fig. 2 indicates the yearly saving and the capitalized value of this saving for various load factors, coal costs and rates of capitalization. The method of calculating the points is illustrated by Table I, printed on the following page.

The use of the chart for obtaining this information is illustrated by the following problem:


Load Factor %
50 60 70 80 90 100
STEAM TEMPERATURE 600° F.
Vacuum
28"
28½"
29"
700 600 500 400 300
Pressure lb. per sq. in. absolute
FIXED CHARGES %
12 13 14 15 16 17
500 1000 1500 2000 2500 3000 3500 4000
Yearly Savings in Dollars
3.00 3.50 4.00 4.50 5.00 5.50 6.00
30000 25000 20000 15000 10000 5000
Capitalized Value of Yearly Savings – Dollars
Cost of Coal per 2240 lb. – 14000 B.t.u.



FIGS. 1 AND 2—THERMAL EFFICIENCIES AND WATER RATES OF TURBINES WITH DIFFERENT STEAM PRESSURES, AND METHOD OF ASCERTAINING CAPITALIZED VALUE OF SAVING POSSIBLE WITH HIGHER STEAM PRESSURES

Problem.—What would be the yearly saving and value of the saving, capitalized at 17 per cent, resulting from an increase in pressure from 200 lb. (14 kg.) to 500 lb. (35 kg.), keeping the steam temperature constant at 600 deg. Fahr. and the vacuum at 28 in. (70

*Reproduced from an article by the author in the ELECTRICAL WORLD of Dec. 8, 1917.

cm.). Boiler and furnace efficiency is assumed to be 70 per cent, load factor 60 per cent and cost of 14,000 B.t.u. coal $5 per 2240 lb. (1016 kg.).

Solution.—On the 500-lb. line in the upper left-hand quadrant of the chart project upward to 28-in. vacuum line, then horizontally to the 60 per cent load-factor line, vertically downward to the $5 coal line, then horizontally again to the left, where the annual saving ($1,400) will be found. Continue vertically to the left to the 17 per cent capitalization line, then vertically downward, and read the capitalized value as $8,250.

TABLE I—RELATIVE COAL COSTS AT 200 LB. AND 500 LB. STEAM PRESSURE

Steam Temperature, 600 Deg. Fahr. Vacuum, 28 In.

	200 Lb.	500 Lb.
Rankine thermal efficiency (per cent)	30.9	35.0
Rankine efficiency ratio (per cent)	76.7	74.0
Combined boiler efficiency (per cent)	70.0	70.0
Load factor (per cent)	60.0	60.0
Coal cost, 2240 lb., 14,000 b.t.u.	$5.00	$5.00
B.t.u. equivalent of one kw.-hr	3415	3415
Unit of capacity (kw.)	1000	1000

Cost per day (200 lb. pressure):

$$\frac{3415\times1000\times24\times0.60\times5}{0.70\times0.309\times0.767\times2240\times14,000}=\$47.20$$

Cost per day (500 lb. pressure):

$$\frac{3415\times1000\times24\times0.60\times5}{0.70\times0.35\times0.740\times2240\times14,000}=\$43.35$$

Daily saving = $47.20 − $43.35 = $3.85.
Yearly saving = $3.85 × 365 = $1,405.
Capitalized value of $1,405 at 17 per cent = $8,265.

This means that $8.25 per kilowatt is the maximum increase in cost which could be paid for the benefits of 500 lb. pressure under the conditions. It is interesting in this connection to refer to Table I, which shows an estimate of the increase in cost of equipment to take care of higher pressures.

It may be noted that for 500 lb. pressure the estimated increase in total cost of the plant is 4.40 per cent. Referred to a cost of $80 per kilowatt of plant capacity at 200 lb., the cost of a 500 lb. plant would be approximately $83.50, or $3.50 more per kilowatt. This partly offsets the $8.25 per kilowatt obtained from Fig. 2, but still leaves $4.75 as the net gain. The yearly saving corresponding to this capitalized figure is $810 per thousand kilowatts of capacity. While there may be some factors which will decrease this amount somewhat, it is believed that the change will be profitable and that a large part of the estimated gains will be realized.

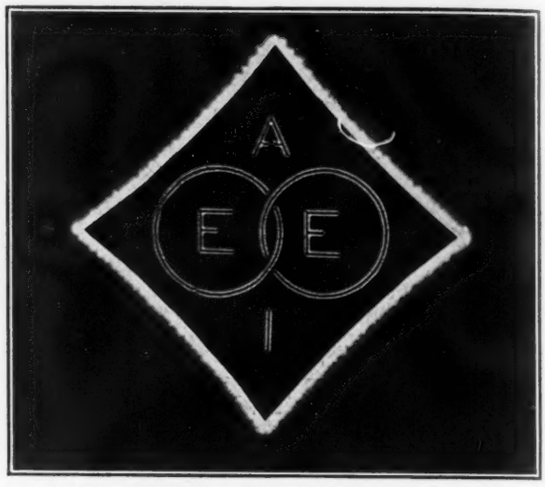
TABLE II—PER CENT* INCREASE IN TOTAL COST OF PLANT WITH ADOPTION OF DIFFERENT PRESSURES

Item	Pressure (Lb.)			
	300	400	500	600
Boilers	0.75	1.50	2.20	2.90
Turbines	1.40	1.40	1.40	1.40
Condensers	−0.20	−0.40	−0.50	−0.60
Economizers	0.00	0.00	0.00	0.00
Piping	0.50	0.90	1.30	1.70
Total percentage increase	2.45	3.40	4.40	5.40

*Referred to 200 lb. as a datum.

An Ornamental Corona Discharge

The illustration shows an interesting example of the use of a corona discharge for a practical purpose. The A. I. E. E. emblem was formed of copper wire, No. 18 B. & S., embedded in a mica shield and energized with 30,000 volts at a frequency of 200,000 cycles per second. This is probably the first time that a corona phenomenon has been turned to practical advertising use. The demonstration took place very recently at a meeting of the Toronto Section of the A. I. E. E. On this occasion a paper was read by W. P. Dobson on the subject of "High-Voltage Phenomena."



PUTTING A PHENOMENON TO PRACTICAL USE

Electrification at St. Louis

The Anheuser-Busch Brewing Association, St. Louis, Mo., is building a seven-story structure covering an entire city block. In the design of this "Bevo Building" arrangements were made for thirteen railroad tracks about ten cars long, extending into the basement of the building and between umbrella sheds for the purpose of loading cars. It was realized that it would be unsatisfactory to have steam locomotives do the switching under this building. This necessitated the adoption of electric locomotives for that portion of the line.

The Manufacturers' Railway, which consists primarily of switching yards in St. Louis with interchange connections with the other railroads, in following its policy of general improvement has now decided to extend the electrification from the Bevo Building switching yard so that electric locomotives can be used in interchanging cars with other lines.

The substation for this electrification is at about the center of the electrified zone. Energy will be purchased from the Union Electric Light & Power Company at 13,200 volts alternating current and will be distributed at 600 volts direct current. The transformation will be performed by one 1050-kva., three-phase, 13,200-volt transformer and one 1000-kw. rotary converter, started from half-voltage taps. Provision was made for installing an extra converter at some future time when the steam locomotives are not helping with the switching, as they are at present.

Precise Measurement of Alternating Currents

Elements of Two Identical Electrodynamometers so Connected in Wheatstone Bridge that Alternating Current Through Elements Can Be Ascertained by Measuring Direct Current That Produces Zero Torque

BY C. O. GIBBON

A PRECISION method of measuring alternating currents which involves relatively simple apparatus and in which disturbing influences of all kinds are eliminated or minimized so that their effects are negligible has been investigated by the writer to determine the accuracy of the method. In brief, the apparatus required consists of two identical electrodynamometers, the fixed and movable coils of which are inserted in the arms of a Wheatstone bridge so that if an alternating current is allowed to flow through the coils its value can be ascertained by measuring the direct current required in the same coils to produce zero torque.* In other words, conditions are adjusted so that there is no deflection of the electrodynamometer and the value of the alternating current is determined by measuring the direct current with a potentiometer.

Theory Involved.—The principles which are involved can be explained by considering the bridge circuit *fbgd* (Fig. 1). Let *A* and *a* represent respectively the fixed and suspended coils of one electrodynamometer, and *C* and *c* the coils of an exactly similar instrument. Denoting the resistance by *R*, the self-inductance by *L* and the mutual inductance by *M*, with the proper subscripts to designate the various arms of the quadrilateral or bridge circuit, let it be assumed that the following electrical conditions are satisfied:

$$R_A = R_C = R_a = R_c \qquad \text{ohms} \quad (1)$$

$$L_A = L_C,\ L_a = L_c \qquad \text{henries} \quad (2)$$

$$M_{Aa} = M_{Cc} \qquad \text{henries} \quad (3)$$

R_A includes, of course, the whole resistance in the arm *fb*, and similarly with the other elements.

If across the terminals *b* and *d* of such a circuit a continuous emf. be impressed by inserting a storage battery controlled by the switch S_c, a continuous current of I_c will flow through the external circuit bS_cd. Owing to the conditions assumed, this current will divide equally between the two sides of the bridge, $I_c/2$ amp. flowing through the side *bgd*, and $I_c/2$ amp. flowing through the side *bfd*. Since the resistances of the arms are equal, the potential difference from *f* to *g* caused by the continuous current is zero. Hence *f* and *g* may be connected together with a wire, or any conditions desired may be imposed upon the external circuit fS_ag, without either disturbing the continuous currents through the various arms of the bridge or affecting the external circuit bS_cd. Conversely, any variation in the external circuit bS_cd will in no way either affect the external circuit fS_ag or disturb the distribution of continuous currents through the various arms of the bridge circuit.

Likewise, if an alternating emf. be impressed across the terminals *f* and *g* of the bridge circuit by closing the switch S_a, an alternating current of I_a r.m.s. amp. will flow through the external circuit fS_ag. Owing to the conditions assumed at the outset, this current will divide equally between the two sides of the bridge, $I_a/2$ amp. flowing through the side *fbg*, and $I_a/2$ amp. flowing through the side *fdg*. The potential difference from *b* to *d* caused by this alternating current will be zero. Hence *b* and *d* may be connected together by means of a wire, or any desirable conditions imposed upon the external circuit bS_cd, without either disturbing the alternating current through the various arms of the bridge circuit or affecting the external circuit fS_ag. Conversely, any variation in the external circuit

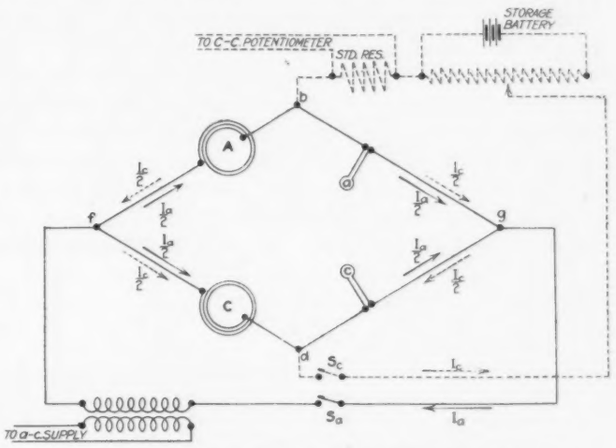


FIG. 1—D.C.-A.C. BRIDGE IN SIMPLIFIED FORM

fS_ag will in no way either affect the external circuit bS_cd or disturb the distribution of alternating currents through the various arms of the bridge circuit.

From the above considerations it is evident that a continuous emf. may be impressed across *bd* simultaneously with an alternating emf. across *fg* without the resulting currents interfering with each other beyond the terminals of the bridge circuit. Within the bridge circuit, however, the alternating and direct currents will be superposed through the coils of each of the electrodynamometers *A*,*a* and *C*,*c*.

Resultant Torque.—Considering instrument *Aa* only, let *i* equal the instantaneous value of the complex harmonic current, of r.m.s. value I_a, which flows through the instrument. Then

$$i = \sqrt{2}[I_1 \sin \omega t + I_2 \sin (2\omega t + \beta_2) + I_3 \sin (3\omega t + \beta_3) + \ldots] \qquad \text{instantaneous amp.} \quad (4)$$

and, as can be easily demonstrated,

$$I_a^2 = I_1^2 + I_2^2 + I_3^2 + \ldots \qquad \text{r.m.s. amp.} \quad (5)$$

The even harmonics are usually negligible.

During one-half of the cycle the current through the

*The employment of an electrodynamometer in a null or zero-reading method for precise measurements of alternating currents was originally suggested by Drs. F. A. Wenner and E. Weibel at the Bureau of Standards. It was communicated by them to Dr. A. E. Kennelly at Harvard University, under whose direction the writer made this investigation on the use of the method. Since the conclusion of the research information has been received from the Bureau of Standards that the method has been tested there with very satisfactory results. Inasmuch as the method was first developed at the bureau, the writer is indebted to that body for permission to announce his results, and he is also under obligation to C. W. Whitall for assistance in making the tests at the Massachusetts Institute of Technology.

fixed coil A (Fig. 1) is $(I_c/2 - i/2)$ amp., and that through the suspended coil a is $(I_c/2 + i/2)$ amp., taking the positive directions of the continuous currents as designated by the dotted arrows. During the other half of the cycle the fixed coil receives $(I_c/2 + i/2)$ amp., and the suspended coil $(I_c/2 - i/2)$ amp.

The instantaneous torque developed by an electrodynamometer, being proportional to the product of the

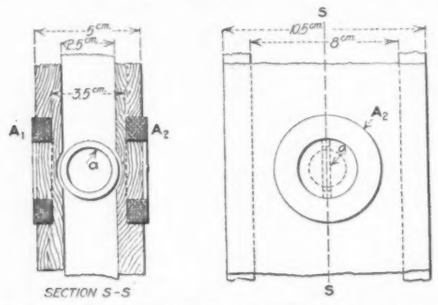


FIG. 2—FORM AND ESSENTIAL DIMENSIONS OF ONE OF THE ELECTRODYNAMOMETERS AFTER REMODELING

All coils are of enameled copper wire. The two fixed coils A_1 and A_2 have a combined resistance of about 116 ohms at 25 deg. C. and a combined inductance of nearly 0.15 henry. Each is composed of 1390 turns of No. 30 A. W. G. wire of bare diameter 0.255 mm., enameled to about 0.274 mm. The movable coil contains 676 turns of No. 38 A. W. G. of bare diameter 0.101 mm., enameled to about 0.112 mm. It has a resistance of about 115 ohms at 25 deg. C. and an inductance of 14.5 millihenries.

instantaneous currents in fixed and movable elements, is at any moment

$$T' = (k/4)(I_c + i)(I_c - i) \quad \text{dyne perp. cm.} \quad (6)$$

where k is a constant depending upon the construction and adjustment of the instrument and is so chosen that T' will be the torque, in dynes perpendicular to a radius of 1 cm., set up by a current of 1 amp. passing steadily through both elements. Then

$$T' = (k/4)(I_c^2 - i^2) \quad \text{dyne perp. cm.} \quad (7)$$

The average resultant torque T during one complete cycle of the fundamental frequency is

$$T = \frac{k}{4} \times \frac{1}{2\pi} \int_{\omega t = 0}^{\omega t = 2\pi} (I_c^2 - i^2)\, d(\omega t) =$$

$$\frac{k}{4} \times \frac{1}{2\pi} \left[\int_{\omega t = 0}^{\omega t = 2\pi} I_c^2 d(\omega t) - \int_{\omega t = 0}^{\omega t = 2\pi} i^2 d(\omega t) \right] \text{dyne perp. cm.} \quad (8)$$

$$= \frac{k}{4} I_c^2 - \frac{k}{4} \times$$

$$\frac{1}{2\pi} \int_{\omega t = 0}^{\omega t = 2\pi} 2[I_1 \sin \omega t + I_2 \sin(2\omega t + \beta_2) + \ldots]^2 d(\omega t)$$

dyne perp. cm. (9)

$$= \frac{k}{4}[I_c^2 - (I_1^2 + I_2^2 + \ldots)] = \frac{k}{4}(I_c^2 - I_a^2) =$$

$$k\left[\left(\frac{I_c}{2}\right)^2 - \left(\frac{I_a}{2}\right)^2\right] \text{dyne perp. cm.} \quad (10)$$

The first integral in equation (8) is the steady torque which would be produced by a continuous current $I_c/2$ in both elements acting alone. The second integral is the average resultant torque which would be produced by the alternating current passing through both coils and acting alone.

The resultant torque T must therefore vanish when the alternating current is of such strength that its torque just equals the torque produced by the continuous current. According to equation (10) this will occur when the root-mean-square value of the alternating current I_a in the external circuit fS_ag is numerically equal to the steady value of the continuous current I_c in the external circuit bS_cd. Exactly the same conclusions may be reached by a consideration of the instrument C,c (Fig. 1).

Therefore an alternating emf. may be impressed across gf, the current I_c regulated with a suitable rheostat till the deflection of A,a is zero, and I_c then determined to any desired degree of precision by measuring, with a direct-current potentiometer, the drop in potential across the standard resistance in Fig. 1. The r.m.s. value of I_a will then be numerically equal to the measured value of I_c.

Simplification Possible.—Since only the instrument A,a needs to be observed, the instrument C,c, which serves merely as a pair of impedances to balance the impedances of A,a, need not be constructed in the form of a dynamometer. However, to facilitate satisfying the conditions previously mentioned it is advisable to use a duplicate dynamometer instrument in which the movable coil, instead of being suspended, may be so adjusted as to occupy any desired position relative to the fixed coil. If, so far as their electric and magnetic circuits are concerned, the two instruments are thus exact duplicates, equations (1) and (2) will be satisfied; while if the position of c relative to C is adjusted to exactly that of a relative to A, equation (3) will be satisfied. By arranging the working instrument so that the zero position of a is perpendicular to A, and adjusting the coils of the "dummy" electrodynamometer so that they are mutually perpendicular, then there is no appreciable stray magnetic flux from one instrument to the other if the two are sufficiently separated. Thus mutual inductance is eliminated from consideration and

$$M_{Ac} = M_{Aa} = M_{Ca} = M_{Cc} = 0 \quad \text{henries} \quad (11)$$

The Experimental Instrument.—In order to secure the necessary equalities among the constants of the bridge circuit and to avoid any possible trouble from eddy currents in the frames of the instruments, a pair of wooden-box laboratory galvanometers were used for conversion into electrodynamometers, one as the working instrument and the other as the "dummy." The

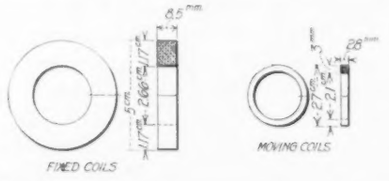


FIG. 3—DETAILED DIMENSIONS OF COILS USED IN ELECTRODYNAMOMETER

two instruments were identical except that the movable coil of the dummy instrument was mounted in a wooden spindle so that it could be set at any desired angle with respect to the fixed coils.

Although theoretically possible, it is not practically feasible to construct two exactly similar instruments which will conform with adequate precision to equations (1) and (2). To obtain the exact balance of the

quadrilateral or bridge circuit required for precise measurements, it was necessary to add small adjustable resistances and inductances in the various arms external to the instruments themselves (Fig. 4).

To render the working instrument independent of the earth's magnetic field, a compensating bar magnet was so placed that when the movable coil is energized alone with continuous current, by having key *m* and a plug at *h* open and closing key *w*, no deflection occurs. The deflection of the movable coil was observed in the

ACCURACY WITH NULL-READING ELECTRO-DYNAMOMETER METHOD OF MEASURING ALTERNATING CURRENTS

Reading No.	A. C. (Amp.)	D. C. (Amp.)	Difference* (Amp.)	Difference* (per Cent)
1	0.005415	0.005530	+0.000115	+2.08
2	0.009700	0.009745	+0.000045	+0.462
3	0.011705	0.011717	+0.000012	+0.118
4	0.013615	0.013610	−0.000005	−0.0368
5	0.015410	0.015424	+0.000014	+0.0906
6	0.018315	0.018321	+0.000006	+0.0337
7	0.035075	0.035010	−0.000065	−0.185
8	0.053037	0.053167	+0.000130	+0.246
9	0.081510	0.081641	+0.000131	+0.161
10	0.098560	0.098443	−0.000117	−0.119

*The percentage errors are based upon the direct-current readings; +indicates that the direct-current reading is greater than the alternating-current; −indicates that the alternating-current reading is greater than the direct-current.

usual manner by means of a mirror and beam of light reflected from a scale into a telescope. The motion of the movable coil is damped by means of a mica vane submerged in oil.

Method of Balancing and Results Obtained.—The continuous current used for balancing the alternating current was obtained from a storage battery, while the alternating currents to be measured were supplied through the choke coils *Z* and *t* from the secondary coil of a transformer excited by a 60-cycle sine-wave alternator. As indicated in Fig. 4, both the alternating and direct currents, after being balanced on the differential electrodynamometer, were measured in succession by one and the same Drysdale-Tinsley a.-c.-d.-c. potentiometer. The dynamometer was balanced by adjusting the slide wire of resistance *r* until no deflection was observed on opening or closing *m*. The alternating-current and direct-current drops of potential across the standard 10-ohm non-inductive resistances *R* and *R'* were then measured by the potentiometer.

A sinusoidal current is essential to this check, because the tuned vibration galvanometer used with the alternating-current potentiometer responds selectively to the fundamental frequency and will indicate a balance only for I_1 in equation (5). Furthermore, as has already been demonstrated by the algebraic analysis, the differential electrodynamometer balances for the root-mean-square I_a—see again equation (5)—of any ordinary alternating wave form, unless such relatively high-frequency harmonics should be present that capacitance effects are produced between the layers in the windings. In this case an error might be produced in the effect of that particular component. The effect of such errors of small high-frequency components upon the resultant root-mean-square value, however, may be regarded as insignificant.

From the table it may be seen that the average difference between the alternating current and direct current above 10 milliamp. is 0.125 per cent, or 1.25 per mil. By studying the behavior of the instrument with a view to improvement it is believed that a still higher degree of precision could be obtained over a considerably wider range.

Important Where Alternating Current Is Applied.—There is a slight advantage in impressing alternating emf. across *bd* and a continuous emf. across *fg* because the zero position of the movable coil need not then be perpendicular to the fixed coil, a feature of considerable advantage from the practical viewpoint. This is true because if the moving coil of the working instrument should deflect so as to increase the inductance of both elements, more alternating current will tend to flow through *C,c* than through *A,a*, with an alternating emf. impressed across *fg*, thus causing false balances in the differential electrodynamometer. On the other hand, if an alternating emf. be impressed across *bd*, the increase in inductance between *A* and *a* will in no wise disturb the distribution of the alternating currents through the various arms of the Wheatstone bridge.

As a practical laboratory instrument, the differential electrodynamometer should be self-contained. The dummy might advantageously be mounted in the pedestal of the working instrument, with its fixed and movable coils mounted rigidly perpendicular to each other. The fixed and movable elements of each might be designed so as to have very nearly equal resistances and inductances, and so small over-all adjustments of each could be made for the final precision balance. A single set of alternating-current and direct-current adjustments could then be made to equalize the four arms of

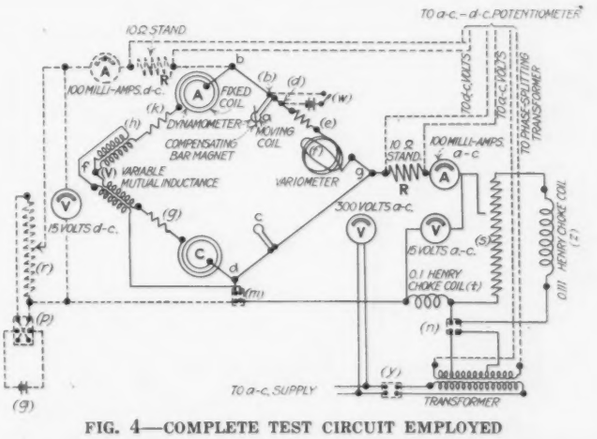


FIG. 4—COMPLETE TEST CIRCUIT EMPLOYED

The alternating-current external circuit is indicated in heavy lines and the direct-current external circuit in broken, light lines. These two external circuits are carefully insulated from each other. A double key *m* permits both circuits to be closed or opened simultaneously. The quadrilateral is adjusted into resistance balance, to satisfy equation (1) by means of the three adjustable resistances *e*, *g* and *k*. Being non-inductive, these resistances can be adjusted without changing the inductance of the arms. The Campbell variable mutual inductance *V* and the variometer *f* make it possible to obtain the inductance balance without disturbing the resistance balance, since the inductance balance can be adjusted thereby to satisfy equation (2) without changing the resistance in the arms. Each arm is balanced against the corresponding arm with both continuous and alternating currents. Mutual inductance between the fixed and movable coils is eliminated, as indicated in the paragraph immediately preceding equation (11).

the quadrilateral. Such an instrument, once adjusted, should prove a very convenient, inexpensive and extremely accurate device for making precise measurements of alternating currents.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CHARTING INSTRUCTIONS TO GET BETTER ECONOMIES

How an Iowa Company Instructs Its Plant Operators to Handle Different Loads and Secures a Record of the Way Plant Is Actually Run

Realizing that the over-all efficiency of its station will reach its maximum if the various generating units are combined to run at the most economical loads for the particular load condition encountered, the Moline-Rock Island Manufacturing Company, Davenport, Iowa, has worked out a scheme for showing its plant operators how to combine the generators to get the best results. Tests were run on the units to determine their efficiencies in terms of steam consumption at various loads within their ratings. While the results of these tests (Fig. 1) can be used by any one having technical skill and judgment to determine the proper combination of machines to carry any load, the company desired to present the information in such form that any operator, regardless of his technical judgment, may determine instantly what to do under ordinary conditions. Consequently all of the more common operating conditions that are likely to arise are listed in a table like that shown herewith, giving the combinations of units to use and the loads on which each unit shall be operated. With this table the operator needs to do no figuring and does not even have to consult the curve sheet.

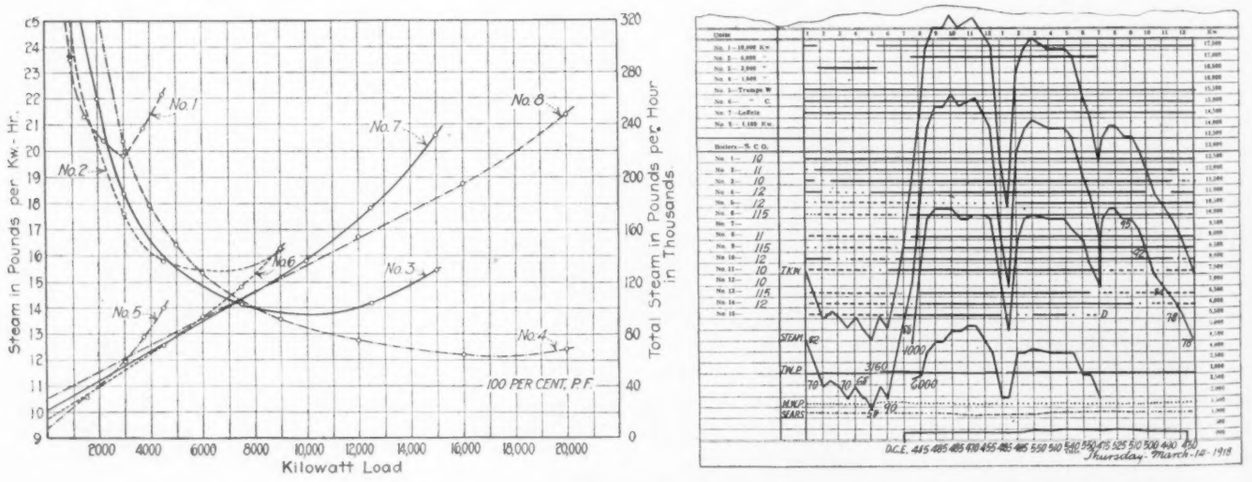
As a detail in connection with the actual making of these charts and curves, it is interesting to observe that the tabulated data are blue-printed on separate sheets and then pasted on the curve sheet. This saves time in changing the tracings as well as the curve sheets when changes in the operating schedule are necessary.

Of next importance to providing proper instructions for handling various loads is the matter of seeing that the instructions are carried out intelligently. The officers of the company keep in touch with this situation through a system of daily power-house reports. In addition to the usual data asked for on daily power-house reports, these reports call for the load curves from each of the plants, the total load curve and a

CHART OF TURBINES TO OPERATE AT DIFFERENT LOADS TO RELIEVE OPERATOR FROM NECESSITY OF RELYING ON HIS OWN JUDGMENT

Kw. Load	Units in Service	Kw. Load per Respective Unit
Up to 1750	3,000	Total load
1,750–4,500	6,000	Total load
4,500–8,000	10,000*	Total load
10,000	10,000 6,000	8,000–9,000 2,000–1,000
12,000	10,000 6,000	9,000–8,000 3,000–4,000
14,000	10,000 6,000	10,000–9,000 4,000–5,000
16,000	10,000 6,000 3,000	10,500–11,000 5,300–4,800 200
18,000	10,000 6,000 3,000	11,500–11,000 6,300–6,800 200
20,000	10,000 6,000 3,000	12,000 7,200 800
22,800	10,000 6,000 3,000	12,000 7,200 3,600

*If two units are used run 6,000 at 200 kw.



STEAM CONSUMPTIONS OF DIFFERENT UNITS AND PORTION OF LOG SHEET USED BY DAVENPORT (IOWA) COMPANY

Curves Nos. 1 and 5 represent the water rates and total steam consumption of a 3000-kw. turbine at 100 per cent power factor and 0 deg. superheat; Nos. 2 and 6 represent the corresponding quantities for a 6000-kw. turbine at 90 per cent power factor and 100 deg. superheat; Nos. 3 and 7, the values for a 10,000-kw. turbine at 95 per cent power factor and 100 deg. superheat, and Nos. 4 and 8, the values for a 20,000-kva. turbine at 80 per cent power factor and 125 deg. superheat.

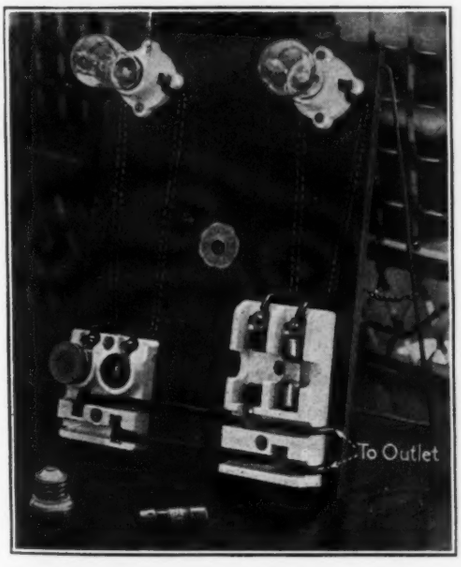
graphical statement of the hours of operation of each turbine and boiler unit. A part of one of these reports is reproduced herewith. The horizontal lines drawn through the load curves are the feature of the report. Each line, it may be observed, is opposite the designation of a turbine or boiler unit at the right margin of the page. The length and position of these lines indicate what machines were used at each hour, and also show in definite relation to the load curve how accurately instructions have been carried out. The lines used to show boiler operation also show whether the boiler was steaming or was banked.

B. J. Denman, president of the Moline-Rock Island Manufacturing Company, is a strong believer in the value of this method of charting operating methods. He has applied it in the past to other plants under his direction, and each time improved economy has resulted.

USE OF SIMPLE PANEL FOR THE TESTING OF FUSES

Permanently Connected Lamps and Fuse Blocks Permit Testing Plug or Cartridge Fuses in Short Space of Time

A panel is in use at the New Haven (Conn.) office of the United Illuminating Company which makes it very convenient to test fuses. As shown herewith, it consists of two 10-watt lamps and two fuse blocks mounted at the top of a 10-in. (25.4-cm.) by 14-in. (35.5-cm.) by ½-in. (1.27-cm.) wooden board equipped with a ⅛-in. (0.32-cm.) wire brace permitting the device to be set upon the counter easel fashion. The fuse blocks are wired in multiple as indicated so that either a plug fuse or a cartridge-type fuse up to those rated at 30 amp. may be tested at a moment's notice. The



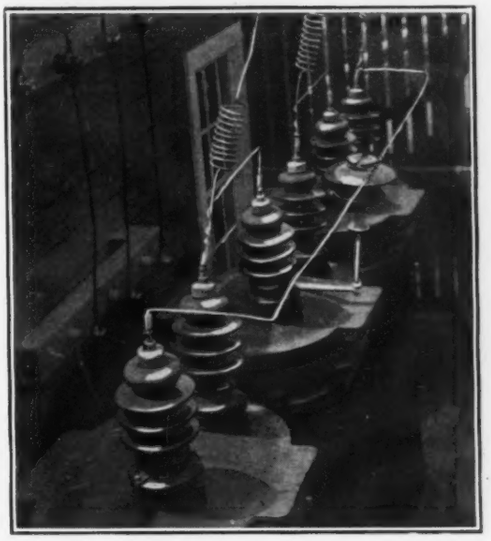
OUTFIT TO TEST CONTINUITY OF PLUG OR CARTRIDGE FUSES

test is for continuity only, the lighting of the lamp above the tested fuse indicating a satisfactory circuit through the fuse under examination. One plug fuse and one cartridge fuse remain in circuit constantly. The thread in the receptacle at the left, where the plug type of fuse is tested, has been hammered down so that no screwing in of the plug is required in testing.

AN INEXPENSIVE MOUNTING FOR TRANSFORMER BUSES

Steel Strap Attached to Case Supports Pin Insulator, Which in Turn Carries Bus—Method Is Both Safe and Neat

When installing small three-phase delta-connected transformer blanks the difficulty of placing the connection between the two end transformers may often be solved, as shown in the accompanying figure, by mount-



BUS CONNECTING TERMINALS AT OPPOSITE ENDS OF BANK SUPPORTED BY PIN INSULATOR ATTACHED TO TRANSFORMER CASE

ing a pin-type insulator directly on the case of the middle transformer. The pin is bolted to a piece of galvanized strap steel, which may in turn be fastened either to one of the cover bolts or one of the bushing bolts of the transformer. The resulting installation is safe, neat and inexpensive and is preferable to buses supported by strain insulators attached to the side walls of the substation or to poles. Where the bushings are of the inverted type it is usually necessary to attach a pin-type insulator to the case of each end transformer.

STAR-CONNECTED DISTRIBUTION VERSUS DELTA-CONNECTED PLAN

Relative Advantages of These Two Systems of Operation as Determined from Experience in Changing System at Madison, Wis.

Summarizing his experience in changing the Madison Gas & Electric Company's distribution system from 2300-volt delta-delta-connected to 2300/4000-volt star-delta-connected circuits, George Wagner, superintendent of distribution, said before the recent Wisconsin Electrical Association:

On account of the increased voltage in the three-phase, four-wire system, the amount of copper required for transmitting the same load over the same distance is very much less than is necesary with the other systems. The change to the four-wire system does not cause a change in voltage on the step-down transformers; therefore the transformers need not be changed. On account of the "Y" connection and the simplicity of regulation attending its use the four-wire system can be used for supplying energy for light, heat and

power purposes from one circuit, thereby overcoming the necessity of parallel circuits. This produces an additional saving in copper.

In order to protect all parts of the circuit against excessive voltage to ground, and to protect the single-phase lighting transformers against excessive voltage, the neutral wire of a three-phase, four-wire circuit should be grounded not only at the station but at a sufficient number of points along the line. Furthermore, the neutral of three-phase transformer banks should be isolated. When the neutral point of a three-phase transformer bank is connected with the neutral wire of the circuit the delta-connected secondaries tend to equalize the phase voltages. Therefore, this should not be done except with transformers of large capacity. If a single-phase load is supplied from one phase of the delta-connected secondaries of a three-phase bank of transformers, the transformer on that phase will supply only one-half of the single-phase current, and the other two transformers will supply the remainder whether the primary neutral point is connected to the neutral wire or not.

PRECAUTIONS TO OBSERVE IN THE STORING OF COAL

Ample Ventilation or Total Exclusion of Air Should Be Afforded—Suggestions for Preventing the Starting of Fires

Heat due to oxidation rather than pressure was given as the main cause of spontaneous combustion of bituminous coal by Prof. H. H. Stoek of the University of Illinois before a recent meeting of the Western Society of Engineers at Chicago. He said that coal should be stored so as entirely to exclude any air, or else adequate ventilation should be provided to keep the coal at a low temperature. Any intermediate conditions are dangerous and should be avoided.

Among precautions which were suggested for preventing spontaneous combustion were: Coals of different varieties should not be mixed while in storage, and the coal should not be piled high on account of the difficulty of moving it in case of fire. If sufficient heating occurs to raise the temperature to 150 deg. Fahr., close watch should be kept on the pile; if the temperature increases to 175 deg. Fahr., it should be moved and cooled before more coal is added. Equipment for storing coal should be arranged to make it possible to move the coal quickly in case of an emergency. To avoid the starting of fires pieces of wood and greasy waste should be carefully removed from storage piles and the coal in storage should be kept away from external sources of heat, such as steam pipes.

PROTECTION OF APPARATUS FROM LIGHTNING STORMS

Types of Arresters to Use With Different-Size Transformers—Necessity of Limiting Discharge Current Through Electrolytic Arresters

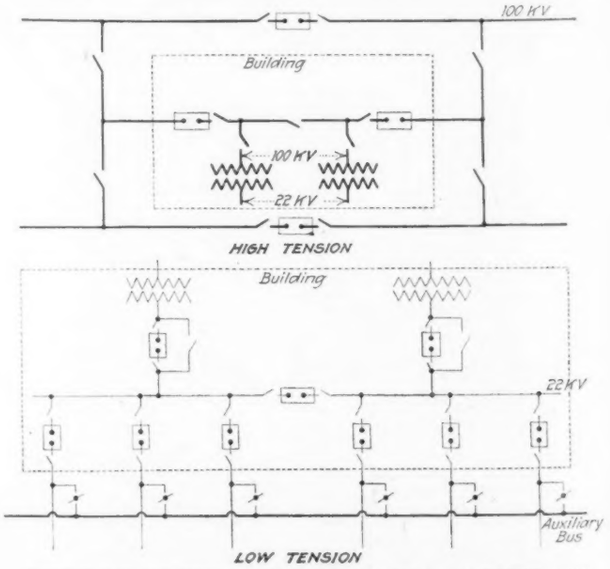
"Protection of Electric Apparatus Against Lightning" was the subject of an address given recently before the transmission and distribution men of Ohio by V. E. Goodwin, lightning arrester engineer of the General Electric Company. He recommended that transformers of 15-kw. rating and less should be protected with the compression-type arrester. Transformers of 150-kw. rating and less should be protected with the graded shunt multi-gap arrester. All transformers above 150-kw. rating should be protected with the electrolytic lightning arrester. Lightning arresters should be installed to protect particular apparatus and therefore should be placed as near the apparatus as possible. The cost of high-tension apparatus, such as transformer lightning arresters, etc., increases as the cube of the voltage ratio increase.

Considering the care of electrolytic arresters, Mr. Goodwin pointed out that this type of arrester is designed for approximately one-half hour's continuous discharge. This is a rather severe condition, however, and should not occur very often. When an electrolytic-type arrester discharges an increase in temperature takes place which will dissolve the film and thereby eliminate the resistance offered to the flow of electricity. This discharge would cause a short circuit if permitted to continue. Fuses in series with the horn-gaps would limit the discharging current and thereby protect them from difficulties of this kind. The ground connection was considered the most vital part of any of the lightning arresters; therefore great care must be used in choosing such grounds and only selecting locations which will assure a normally stable ground.

ARRANGEMENT THAT SERVES PURPOSE OF DOUBLE BUS

Advantages to Be Gained by Using Double Busbars Did Not Justify Increased Cost of Construction—Switches Serve Purpose

In building the Antioch substation of the Great Western Power Company it was decided that the cost of a double busbar system was not warranted solely by the flexibility it would afford. As an alternative plan a single-bus system was installed embodying an arrangement of cut-out switches that would permit obtaining about the same results as when a double-bus system was used.



SINGLE-BUS SYSTEM IN SUBSTATION THAT ANSWERS THE PURPOSE OF DOUBLE-BUS ARRANGEMENT

The accompanying diagram shows the principle utilized, which provides for the isolation of practically every piece of apparatus in the station without interrupting the service. It is estimated that a saving of about $8,000 resulted from the use of the arrangement which is here described.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CHANGING A POWER CONTRACT TO OBTAIN GREATER PROFIT

Massachusetts Company Instead of Charging Railway for Direct-Current Energy Now Charges for Alternating Current, Including Losses

Power for the operation of the Northern Massachusetts Street Railway, serving the Athol-Gardner district of the State, has been furnished by the Athol Gas & Electric Company since 1912. At that time a contract was entered into by which the central station agreed to furnish power measured as direct current at the rate of 1.8 cents per kilowatt-hour and to assume all converting and machine losses. Under the terms of the contract it was necessary for the railway company to build and maintain a three-phase high-tension transmission line from Westminster to the Athol fair grounds, costing about $36,000. On the basis of an annual consumption of 3,000,000 kw.-hr., the interest charge on this investment amounted to $1,800 (at 5 per cent) or 0.06 cent per kilowatt-hour, to which was added the interest and depreciation on the company's steam plants, held in reserve, amounting to 0.8 cent per kilowatt-hour, and thus making the total cost of power to the railway company 2.66 cents. A further condition of the contract was that the railway company should maintain the high-tension line in good condition, but little work had to be done on this in the early years of the contract.

Owing to the fact that the load factor was at times much below normal and that the machine loss was large in the substation installation, the central station found itself unable to furnish power under this contract during certain hours at a profit. The railway claimed also that the service did not attain a standard which would enable it to maintain its schedules at all times. In 1916, when the original contract had eleven years more to run, the Northern Massachusetts company and the Athol company entered into a new contract, extending to 1927, upon a basis which would allow a larger profit to the central station and thus give it the incentive to furnish an improved power supply. As the result of this new arrangement the former troubles have been eliminated and the power supply is now continuous and satisfactory to the managers of the railway.

Under the new contract the cost of power to the road (which has about 31 miles of track), less a discount for payment of bills within fifteen days, is fixed at 1.84 cents per kilowatt-hour, and the energy is measured as alternating current. The railway assumes all converting and machine losses. These amount to at least 20 per cent in the case of this road, or 0.36 cent per kilowatt-hour. Adding interest and depreciation on the cost of the railway company's stand-by steam equipment increases the cost 0.8 cent per kilowatt-hour, making the total cost to the railway 3 cents. The central station took over the transmission line at a cost of $36,000 in making the new contract. The Athol company purchased part of its energy from the New England Power Company at about 1.1 cents per kilowatt-hour and resold as above outlined.

DATA ON RURAL ELECTRIC SERVICE IN WISCONSIN

Analysis Shows How Business Is Handled, Under What Conditions It Is Profitable and Its General Trend

The report of the committee on rural service of the Wisconsin Electrical Association, of which the chairman is A. C. Babson of Watertown, for the year ended Dec. 31, 1917, covered the following points: the number of utilities in the State of Wisconsin serving rural customers and the standard methods of making extensions to serve them; the connected loads, transformer capacities and annual revenues; rural business increase or decrease during the year 1917, and evidence indicating whether this class of business is or is not desirable and profitable.

An analysis of Table I, which covers reports from twenty-six companies, brings to light the following facts: First, in a moderate majority of cases the farmer pays for the extension of primary lines; second, the cost of transformer installations is carried by the farmer in less than one-half the cases reported and by the company in the remaining cases; third, in about one-half the cases the farmer pays for the extension of the secondary lines; fourth, in a majority of cases no refund on the cost of the extensions is made to the farmer where he has contributed to the expense of such extension; fifth, in about one-half the cases single-phase motors only are provided for on rural extensions and provisions for motors rated at more than 5 hp., single-phase, are exceptional; sixth, in a majority of cases lines have not been constructed exclusively for rural-service customers, but have been extended from city lines into well-settled suburban or rural districts—a considerable portion of the rural customers obtain service from low-voltage transmission lines, where the transmission voltage (up to and including 6600 volts) is stepped down direct to 110 or 220 volts; seventh, reports as to whether this class of business is considered profitable or not are divided about equally, yes and no. The average selling price per kilowatt-hour is 6.9 cents. It is interesting to note, however, that this figure is obtained with an average transformer capacity per customer of 1.6 kw. and an average connected load per consumer of 1.4 kw.

Table II recapitulates the findings of the committee in condensed form and compares the findings with those of 1916. The following inferences may be reasonably deduced from the data shown: First, there is an apparent increase in the number of companies furnishing rural service and in the number of rural consumers;

second, the reported maximum distance of distribution has decreased, indicating an increase in saturation; third, a decrease in total kilowatt-hours consumption, but an increase in total operating revenue, the decrease in consumption being due to one of the largest companies reporting 217,000 kw.-hr. less consumption in 1917 than in 1916, and the consumption in general showing an increase; fourth, a slight decrease in connected load and the same step-down transformer capacity per consumer but a noticeable decrease in the average revenue per consumer, which, on account of the greater consumption per customer, would indicate a greater use of the connected load but a lower average rate; fifth, an apparent increase in the kilowatt-hours sold per kilowatt of transformer capacity, which would indicate also a tendency toward greater use of the connected load; sixth, an apparent increase in revenue per kilowatt of transformer capacity, even though at a lower rate per kilowatt-hour, would also indicate a greater use of the connected load.

It should be noted that in computing the units under the last three headings of Table II figures were used only where both component parts of the desired unit were reported. This method gives a reliable unit for all companies reporting the necessary information to compute a given average unit.

Several of the largest electrical utilities of the State, including such as the Milwaukee, Madison, Racine, Kenosha and Waukesha companies, have not as yet indulged extensively in the rural service experiment. The new schedule adopted by the Wisconsin Gas & Electric Company, referred to in last year's report and first applied in the Watertown division during 1917, promises to give fair results owing to the reasonably high minimum monthly charge. Eleven farms were connected up during the year and more are preparing for connections.

Owing to a general retrenchment of all companies in the programs of capital expenditures during the last half of 1917, very little was done along the line of extensions, especially rural extensions. However, even with the present prospect of a shortage of capital for extensions of all kinds, the development of rural ser-

TABLE II—RECAPITULATION OF COMPARATIVE STATISTICS FOR 1916 AND 1917, WISCONSIN RURAL SERVICE, LIGHT AND POWER SERVICES COMBINED

	1916	1917	Increase, per Cent
Total companies reporting	40	37	†−7
Companies reporting customers*	20	24	20
Number of customers	419	738	76
Average number of customers per company reporting rural customers	21	30	42
Maximum distance from station	18	10	....
Total connected load, kw	331	871	163
Kw.-hr. sold per year	446,493	311,460	†−32
Total transformer rating, kw	364	786	116
Total operating revenue	$18,609.00	$22,271.02	19
Data per Customer (Arithmetical Average)			
Connected load, kw	2.0	1.4	†−30
Kw.-hr. sold per year	367	475	29
Transformer capacity	1.6	1.6	Same
Operating revenue per year	$39.00	$33.00	†−15
Data per Kw. of Transformer Rating (Arithmetical Average)			
Kw.-hr. sold per year	233	255	9
Kw. connected load	0.8	0.8	Same
Operating revenue per year	$20.00	$22.00	10
Operating Revenue per Kw.-hr. (Arithmetical Average), Cents			
	9	6.9	†−23

*One company reporting 248 customers in 1917 did not report in 1916.
†Decrease.

TABLE I—CHARACTERISTICS OF RURAL DISTRIBUTION IN WISCONSIN

Location of Company	Total: No. of Customers	Total: Kw. Connected Load	Total: Kw.-hr. per Year	Total: Rating of Transformers, Kw.	Total: Operating Revenue per Year	Per Customer: Connected Load, Kw.	Per Customer: Kw.-hr. per Year	Per Customer: Rating of Transformers, Kw.	Per Customer: Operating Revenue per Year	Per Kw.: Kw.-hr. per Year	Rating of Transformers: Connected Load, Kw.	Rating of Transformers: Operating Revenue per Year	Kw.-hr. Revenue per Year, Cents	Maximum Distance from Station	Farmer Pays for: Prim.	Farmer Pays for: Trans.	Farmer Pays for: Sec.	Meter	Refund	Current: Single-Phase	Current: Three-Phase	Current: Direct	Maximum Size Motor	Lines for Rural Service Only	Profitable	Transformer Voltage	Lines Step Down Direct
Appleton	35	27	10,000	35.0	$967.00	0.8	286	1.0	$27.63	286	0.8	$27.63	10	4	N	N	N	N	..	Y	..	..	5	Y	Y	2,200	Y
Baraboo	52	..	....	....	....	....	....	....	....	....	....	....	..	..	Y	N	Y	N	Y	Either	..	..	5	N	?	6,600	Y
Beloit	33	73	17,745	99.0	1,405.50	2.2	538	3.0	42.59	179	0.7	14.19	8	3½	Yx	N	Y	N	N	Either	..	..	20	N	Y	2,300	Y
Burlington	2	2	440	1.0	42.76	1.0	220	0.5	21.38	440	2.0	42.76	10	1	Y	N	Y	N	Y	Y	..	..	7½	N	N	26,400	N
De Pere	6	48	....	60.0	....	8.0	..	10.0	....	....	0.8	....	..	1½	Yx	N	N	N	..	..	Y	..	1	Y	N	2,200	Y
Durand	6	8	....	12.0	180.00	1.3	..	2.0	30.00	....	0.7	15.00	..	5	N	N	N	N	..	Y	..	..	5	Y	N	6,600	Y
Edgerton	53	43	12,928	60.5	913.06	0.8	244	1.1	17.23	214	0.7	15.10	7	5	Yx	N	N	N	..	Y	..	..	..	Y	Y	2,300	Y
Fort Atkinson	17	26	8,648	23.5	670.71	1.5	509	1.4	39.45	368	1.1	28.54	8	1½	Y	Y	Y	N	N	Either	..	..	5	N	Y	2,300	Y
Glenwood	7	8	1,986	12.0	238.00	1.1	284	1.7	34.00	166	0.7	19.83	12	3½	Y	Y	Y	N	N	Y	..	..	15	N	Yx	2,300	Y
Grafton*	14	15	3,500	40.0	375.00	1.1	250	2.9	26.79	88	0.4	9.38	11	3	N	N	Y	N	N	Y	..	..	..	N	Y	2,200	Y
Green Lake	3	4	1,143	33.0	124.05	1.3	381	11.0	41.01	36	0.1	3.76	11	2	N	N	N	N	Y	Either	..	..	2	N	Y	....	....
Hudson	4	35	....	40.0	455.00	8.8	..	10.0	113.75	....	0.8	11.38	..	7	Y	Y	Y	N	N	..	Y	..	10	N	N	13,200	Y
Janesville	29	55	20,187	53.5	1,095.38	1.9	696	1.8	37.77	377	1.3	20.47	5	5	Yx	N	N	N	N	Either	..	..	..	Y	Y	6,600	Y
Lake Geneva	8	7	5,771	19.0	338.54	0.9	721	2.4	42.32	304	0.4	17.82	6	10	..	..	..	..	..	Y	..	..	5	Y	Y	26,200	N
Lake Mills	12	25	7,800	20.0	624.00	2.1	650	1.7	52.00	390	1.3	31.20	8	5	Y	Y	Y	Y	..	..	Y	..	2	Y	..	6,600	N
Mineral Point†	10	3	2,066	4.0	229.72	0.3	207	0.4	22.97	517	0.8	57.43	11	1	Y	Y	Y	N	Y	Y	..	..	..	N	..	13,200	N
Oakfield	4	..	3,538	....	227.39	..	885	....	56.85	....	..	....	7	5	Y	Y	Y	N	N	..	Y	..	15	Y	N	6,600	Y
Oshkosh‡	37	..	7,293	....	756.00	..	197	....	20.43	....	..	....	10	..	..	..	..	..	..	..	..	..	..	N	..	....	....
Rhinelander	4	3	1,709	....	117.43	0.8	427	....	29.36	....	..	....	7	2	Y	N	N	N	N	Y	..	..	10	N	N	12,000	N
Rice Lake	..	..	....	....	....	..	..	....	....	....	..	....	..	..	N	N	N	N	N	Y	..	..	15	N	N	6,600	Y
Sheboygan	120	197	109,949	....	4,878.64	1.6	916	....	40.65	....	..	....	4	9	Yx	N	N	N	Y	Either	..	..	..	Y	N	13,200	Y
Sturgeon Bay¶	..	..	....	....	....	..	..	....	....	....	..	....	..	9	Y	Y	Y	N	N	Y	..	..	10	N	N	6,600	Y
Washburn§	10	..	....	....	....	..	..	....	....	....	..	....	..	2½	Y	Y	Y	Y	N	Y	..	..	3	N	Y	2,300	Y
Watertown*	11	15	6,000	20.0	400.00	1.4	545	1.8	36.36	300	0.8	20.00	7	3	N	N	N	N	..	Y	..	..	..	Y	N	2,300	Y
Wausau	8	12	5,478	....	514.96	1.5	685	....	64.37	....	..	....	11	10	Y	N	Y	N	N	Y	..	..	10	N	?	4,800	Y
																										13,200	N
Winona¶ (office reporting)	248	256	85,279	158.5	7,634.88	1.0	344	0.6	30.79	538	1.6	48.17	9	3	N	N	N	N	N	Either	..	..	..	Y	N	22,000	N
Wittenberg	5	9	....	9.5	103.00	1.8	..	1.9	20.60	....	0.9	10.84	..	12	..	..	..	N	N	Either	..	..	3	N	Y	6,600	Y
Totals	738	871	311,460	786.0	$22,271.02																						

*Estimated. †1916 report. ‡Reports rural service, but gives no detail. §No details reported. ¶Partly Minnesota. xPartly.

vice near existing lines may proceed because of the shortage and demands of farm labor.

Finally it appears to the committee that: First, the construction of purely rural service lines is not ordinarily warranted unless the saturation of service is such that a reasonable return on the added investment and sale of energy may be shown; second, rural service consumers on transmission lines of not more than 6600 volts connecting towns or villages are ordinarily profitable if a suitable minimum charge is made; third, a suitable minimum charge to cover the higher cost of service for rural consumers should be made, variously estimated at from $2 to $3 or more per month; fourth, a low second step in the energy rate should be provided so as to encourage a sufficient use of the service by the farmer to make it practical and attractive to him.

ADVERTISEMENT SERIES ON PUBLIC RELATIONS

Vancouver (B. C.) Electric Railway Property Runs Sixteen Frank Talks of Broad Character in Local Newspapers

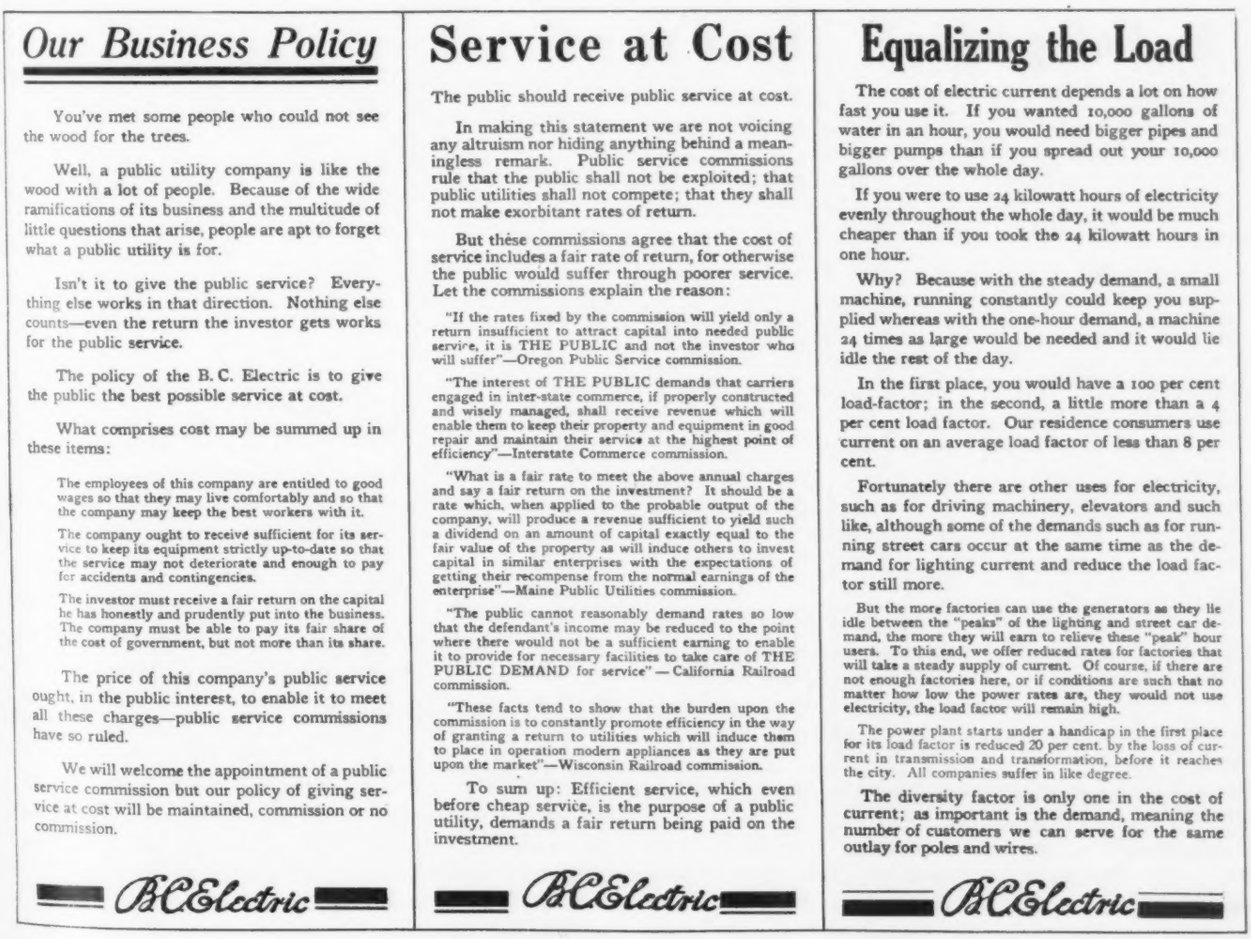
Under the title "Your Electric Service," the British Columbia Electric Railway Company has published a booklet containing a series of talks on electric service which appeared in the daily papers of Vancouver. The talks, sixteen in number, appeared under the following heads: "Servants of the Public," "Our Business Policy," "The Investments for Your Service," "Service at Cost," "Down to Bed-Rock," "A Statement of Finance," "Lower Rates Coming," "Your Street-Lighting Bill," "What Your Service Costs," "Equalizing the Load," "Electric Service Quality," "Striking an Average," "Local Conditions Count," "Preparing for the Future," "The Fixed Costs of Your Service," and "The Future Co-operation."

Three of the talks are reproduced here to show the frankness of this company in its public statements.

APPLIANCE SALES COMMISSION FUND FOR THE SALESPEOPLE

Washington Company's Policy of Distributing Percentage of Profits Develops Organization Spirit and Co-operation

To give an added impulse to appliance sales this year, the Potomac Electric Power Company, Washington, D. C., is setting apart a 5 per cent commission on everything sold out of the electric shop which is paid into a monthly fund and distributed to the members of the sales department. This distribution is made by equal division; that is, if the profit for the month is $250 and there are ten salesmen on the staff, each one receives a check for $25. It is found that this is aiding materially in the development of an organization spirit because of which the men are co-operating eagerly and "tipping each other off" to opportunities discovered outside the discoverer's own territory.



Our Business Policy

You've met some people who could not see the wood for the trees.

Well, a public utility company is like the wood with a lot of people. Because of the wide ramifications of its business and the multitude of little questions that arise, people are apt to forget what a public utility is for.

Isn't it to give the public service? Everything else works in that direction. Nothing else counts—even the return the investor gets works for the public service.

The policy of the B. C. Electric is to give the public the best possible service at cost.

What comprises cost may be summed up in these items:

The employees of this company are entitled to good wages so that they may live comfortably and so that the company may keep the best workers with it.

The company ought to receive sufficient for its service to keep its equipment strictly up-to-date so that the service may not deteriorate and enough to pay for accidents and contingencies.

The investor must receive a fair return on the capital he has honestly and prudently put into the business. The company must be able to pay its fair share of the cost of government, but not more than its share.

The price of this company's public service ought, in the public interest, to enable it to meet all these charges—public service commissions have so ruled.

We will welcome the appointment of a public service commission but our policy of giving service at cost will be maintained, commission or no commission.

B.C. Electric

Service at Cost

The public should receive public service at cost.

In making this statement we are not voicing any altruism nor hiding anything behind a meaningless remark. Public service commissions rule that the public shall not be exploited; that public utilities shall not compete; that they shall not make exorbitant rates of return.

But these commissions agree that the cost of service includes a fair rate of return, for otherwise the public would suffer through poorer service. Let the commissions explain the reason:

"If the rates fixed by the commission will yield only a return insufficient to attract capital into needed public service, it is THE PUBLIC and not the investor who will suffer"—Oregon Public Service commission.

"The interest of THE PUBLIC demands that carriers engaged in inter-state commerce, if properly constructed and wisely managed, shall receive revenue which will enable them to keep their property and equipment in good repair and maintain their service at the highest point of efficiency"—Interstate Commerce commission.

"What is a fair rate to meet the above annual charges and say a fair return on the investment? It should be a rate which, when applied to the probable output of the company, will produce a revenue sufficient to yield such a dividend on an amount of capital exactly equal to the fair value of the property as will induce others to invest capital in similar enterprises with the expectations of getting their recompense from the normal earnings of the enterprise"—Maine Public Utilities commission.

"The public cannot reasonably demand rates so low that the defendant's income may be reduced to the point where there would not be a sufficient earning to enable it to provide for necessary facilities to take care of THE PUBLIC DEMAND for service" — California Railroad commission.

"These facts tend to show that the burden upon the commission is to constantly promote efficiency in the way of granting a return to utilities which will induce them to place in operation modern appliances as they are put upon the market"—Wisconsin Railroad commission.

To sum up: Efficient service, which even before cheap service, is the purpose of a public utility, demands a fair return being paid on the investment.

B.C. Electric

Equalizing the Load

The cost of electric current depends a lot on how fast you use it. If you wanted 10,000 gallons of water in an hour, you would need bigger pipes and bigger pumps than if you spread out your 10,000 gallons over the whole day.

If you were to use 24 kilowatt hours of electricity evenly throughout the whole day, it would be much cheaper than if you took the 24 kilowatt hours in one hour.

Why? Because with the steady demand, a small machine, running constantly could keep you supplied whereas with the one-hour demand, a machine 24 times as large would be needed and it would lie idle the rest of the day.

In the first place, you would have a 100 per cent load-factor; in the second, a little more than a 4 per cent load factor. Our residence consumers use current on an average load factor of less than 8 per cent.

Fortunately there are other uses for electricity, such as for driving machinery, elevators and such like, although some of the demands such as for running street cars occur at the same time as the demand for lighting current and reduce the load factor still more.

But the more factories can use the generators as they lie idle between the "peaks" of the lighting and street car demand, the more they will earn to relieve these "peak" hour users. To this end, we offer reduced rates for factories that will take a steady supply of current. Of course, if there are not enough factories here, or if conditions are such that no matter how low the power rates are, they would not use electricity, the load factor will remain high.

The power plant starts under a handicap in the first place for its load factor is reduced 20 per cent. by the loss of current in transmission and transformation, before it reaches the city. All companies suffer in like degree.

The diversity factor is only one in the cost of current; as important is the demand, meaning the number of customers we can serve for the same outlay for poles and wires.

B.C. Electric

THREE OF A SERIES OF SIXTEEN TALKS TO CENTRAL-STATION CUSTOMERS

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Asynchronous Motors with High Power Factor and Controllable Slip.—R. V. PICOU.—Description of a method of improving power factor by the use of an asynchronous motor so arranged that it has a power factor practically equal to unity at all loads and that the slip can be controlled without sensible alteration of output. The machine can be used as a generator as well as a motor without the aid of auxiliary apparatus to give it an imposed frequency. The construction proposed permits a notable increase of the air gap without detriment to the motor characteristics—an evident mechanical advantage.—*Revue Générale de l'Electricité*, March 30, 1918.

Lamps and Lighting

Fundamentals of Illumination Design.—WARD HARRISON.—The writer deals with the subject in the following sequence: the candle, the mean spherical candlepower, the lumen, the foot-candle, the relation between the foot-candle and lumen, photometric measurements, including the horizontal photometer and the sphere photometer, and the calculation of the candle-power distribution curve. Concluding, he says: "In calculating the flux of light in various zones, we usually find it convenient to calculate for zones of 10 deg., and it is sufficiently accurate for most purposes to assume that the candlepower value at the center of each 10-deg. zone represents the average candlepower of the zone." He then gives the factors by which such candlepower values should be multiplied to give the lumens in each zone.—*General Electric Review*, May, 1918.

Generation, Transmission and Distribution

Questionnaire on Power Conservation.—Economies that can be effected in both hydroelectric and steam generating plants and information on present-day conditions in California are outlined.—*Journal of Electricity*, April 15, 1918.

Increasing Power Plant Economy.—C. T. BAKER.—Considerable saving may be effected by proper maintenance of apparatus, says the writer, who points out causes of high maintenance expense and suggests methods of preventing them.—*Power Plant Engineering*, April 1, 1918.

Canada's Water Powers and Their Relation to the Fuel Situation.—J. B. CHALLIES.—Water power must take a very prominent part, the writer points out, if the best use of the varied fuel resources of Canada is to be achieved. Furthermore, there must be evolved a national fuel policy which will permit the best possible co-ordinated and concomitant development and use of all the fuel resources in the Dominion. The relation of "white coal" to coal, wood, peat, oil and gas is gone into. The Pacific and Atlantic provinces are self-sustaining as regards fuel, but one area in Canada is largely dependent on imported coal. Canada is fortunate in the extent and location of her water powers, but only a small portion, not 10 per cent, of Canada's available water power is developed. Summarizing the use of water power in Canada, the author says that about 78 per cent of the total power developed (1,348,490 hp.) is taken for municipal use, including domestic and ordinary industrial purposes; about 14 per cent (248,075 hp.) is utilized for paper and pulp industries, and about 8 per cent (140,000 hp.) is employed for electrochemical and similar processes. The products of the electrochemical industry are extremely diversified, and include aluminum, silicon, calcium carbide, cyanamide, ferro-alloys, graphite, carborundum, chlorine, etc. The electrometallurgic industry is in its infancy and promises great expansion, especially in the production of NiCu steel in Canada. The article also includes a diagrammatic representation of the Canadian coal situation and a statistical chart showing the fuel power resources of Canada.—Toronto *Electrical News*, April 15, 1918.

TABLE I—APPROXIMATELY ACCURATE DATA ON PROVINCIAL DISTRIBUTION OF DEVELOPED AND UNDEVELOPED WATER POWERS IN SETTLED PART OF DOMINION*

Province	Power Available	Power Developed
Ontario	5,800,000	789,466
Quebec	6,000,000	520,000
Nova Scotia	100,000	21,412
New Brunswick	300,000	13,390
Prince Edward Island	3,000	500
Manitoba	.....	76,250
Saskatchewan	3,500,000	100
Alberta	.....	32,860
British Columbia	3,000,000	269,620
Yukon	100,000	12,000
Totals	18,803,000	1,735,598

*Prepared by the Dominion Water Power Branch.

TABLE II—EXTENT OF WATER DEVELOPMENT IN EUROPE AND NORTH AMERICA*

Country	Area, Sq. Miles	Population	Hp. Available	Hp. Developed	Per Cent Utilized	Hp. Available per Square Mile	Hp. Developed per Square Mile	Hp. per Capita	
								Available	Developed
U. S. A.	2,973,890	98,783,300	28,100,000	7,000,000	24.9	9.4	2.35	0.28	0.071
Canada, A‡	2,000,000	8,033,500	18,803,000	1,735,000	9.2	9.4	0.87	2.34	0.216
Canada, B‡	927,800	8,000,000	8,094,000	1,725,000	21.3	8.7	1.86	1.01	0.216
Austria-Hungary	261,260	51,173,800	6,460,000	566,000	8.8	24.8	2.17	0.13	0.011
France	207,500	39,601,500	5,587,000	1,100,000	11.6	26.8	3.14	0.14	0.016
Norway	124,130	2,391,780	5,500,000	1,120,000	20.4	44.3	9.02	2.30	0.468
Spain	190,401	19,588,700	5,000,000	440,000	8.8	26.3	2.31	0.26	0.022
Sweden	172,960	5,522,400	4,500,000	704,500	15.6	26.0	4.08	0.81	0.127
Italy	91,400	28,601,600	4,000,000	976,300	24.4	43.8	10.7	0.14	0.034
Switzerland	15,976	3,781,500	2,000,000	511,000	25.5	125.2	32.0	0.53	0.135
Germany	208,803	64,926,000	1,425,000	618,100	43.4	6.8	2.96	0.02	0.010
Great Britain	88,729	40,831,400	963,000	80,000	8.3	10.9	0.91	0.02	0.002

*Dominion Water Power Branch estimate, slightly revised. ‡A excludes Yukon and northern area unlikely to be immediately developed; B included in A is area actually settled.

Traction

Four Improved Types of Electric Locomotives.—Traffic demands and economic considerations have brought about recent developments in electric locomotives which are described in this article. Performance characteristics and several drawings of the electric locomotive are included.—*Railway Electrical Engineer*, April, 1918.

Rolling Stock in the United States.—J. CARLIER.—An elaborate article well illustrated and covering many electric railways in America and also some in England. The author says that the economic future of European railways demands their Americanization, particularly as regards large cars, automatic power, standardized material and construction that minimizes hand work.—*Revue Générale de l'Electricité*, March 30, 1918.

Installations, Systems and Appliances

Transmission-Line Practice.—LIEUT. E. C. DRIVER and E. V. PANNELL.—Fifth installment on the subject, dealing with some problems involved in transmission-line construction and operation. Data are given on the spacings required with pin and suspension-type insulators for different voltages, the number of disks required in suspension insulators for different voltages under different weather conditions, and the maximum operating voltages which will not cause corona in fair weather.—Toronto *Electrical News*, April 1, 1918.

Automatic Substation.—R. J. WENSLEY.—The economies which have been effected in automatic substations adopted by the Ohio Electric Railway Company are discussed.—*Electric Railway Journal*, April 13, 1918.

Compression Rheostats.—ARTHUR H. ALLEN.—Carbon possesses the following properties which make it particularly useful for rheostats: (1) low internal and high contact resistance; (2) it is not readily oxidized; (3) it is imperishable; (4) it passes immediately from a solid to a gaseous state if raised to high enough temperatures and, having no plastic or liquid state, will not weld; (5) it is not affected by moisture, not readily acted upon by chemicals and not subject to corrosion; (6) its specific heat is high, and, when out of contact with circulating air, it will endure high temperatures approximating those of the electric arc; (7) its temperature coefficient is negative. The use of carbon in compression rheostats is discussed in this article.—*Journal of the Engineers' Club of Philadelphia*, April, 1918.

Electricity in the Silk Industry.—CH. VALLET.—The most important advantage of electricity in the weaving industry, the author says, is the almost perfect regularity of speed, which prevents the frequent breaking of the thread that is likely to result with the use of steam or gas engines. Speed regularity is not necessarily contingent on a constant rate of charge, and the degree of speed can be increased to a certain extent without many more broken threads resulting. Electric operation has brought about an increase of production ranging from 5 to 20 per cent, and it has made possible more compact installations, with a large saving in the cost of buildings, shafts and belts. The author examines at length the question of individual versus group operation. Speaking generally he holds that control by groups is preferable in a workshop containing a great number of machines working in virtually identical conditions and in a uniform manner. This is the case in silk manufactories.—*L'Industrie Electrique*, March 10, 1918.

Cincinnati's New Source of Electrical Energy Supply.—The condensers are set very low to reduce the amount of pumping necessary, and large overhead bunkers are avoided to reduce the amount of steel required in the building. The most radical departure is the location of the switch house over the turbine room. This construction permits extensions being made in several directions when necessary.—*Power Plant Engineering*, April 1, 1918.

High-Voltage Circuit-Breaker Details.—L. R. GOLLADAY.—High voltage necessitates greater insulation distance between the conducting parts and grounded tank, so large oil tanks are used. For the higher voltages the simple porcelain terminal bushings are not satisfactory and stronger and more effective condenser types are required. The higher voltages also make it necessary to have a greater travel of the moving contacts and wider separation of the fixed contacts. For this reason moving parts are heavy and there is difficulty in accelerating and decelerating them. A high rate of acceleration is desirable in order to reduce to a minimum the time the arc exists between the contacts. One type of oil circuit breaker which meets the requirements is described.—*Electric Journal*, April, 1918.

Designing and Operating Substations for Maximum Efficiency.—Apparatus standardization and the elimination of equipment not necessary for safe and reliable operation are the principal subjects discussed. Features of the Cedar Avenue substation of the Cleveland Railway are described.—*Electric Railway Journal*, April 13, 1918.

Electrical Reversing Rolling Mill.—The electrical equipment necessary for reversing rolling mills in steel works is described.—London *Engineering*, March 15, 1918.

Electrophysics and Magnetism

Lifting Magnets.—J. REYVAL.—A well-illustrated review of the different situations presented in the lifting and carrying of the materials of industry with respect to the manner in which electromagnets can be utilized for this work.—*Revue Générale de l'Electricité*, March 16, 1918.

Active Power and Reactive Power.—J. B. POMEY.—The author's object is to extend the known relations between active power and reactive power by means of vectorial calculations. He shows that the mean active electrical power is equal to the mean calorific power and that there is a constant relation equal to 4 ω between the mean reactive power and the mean of the difference between the electrical energy and the magnetic energy.—*Revue Générale de l'Electricité*, March 2, 1918.

Terrestrial Magnetism.—L. B. BAUER.—The results of magnetic, atmospheric electric, terrestrial magnetic and terrestrial electric observations and other work done by the department of terrestrial magnetism are set forth in this article.—*Annual Report of Directory of Department of Terrestrial Magnetism*, Carnegie Institute of Washington.

The Sign of the Zinc Electrode.—WILDER D. BANCROFT.—With electrodes which form cations the electromotive force is a measure of the difference of the

chemical potentials, but the sign is opposite; with electrodes which form anions the sign is the same. Therefore, since the electrical potential of the copper in the Daniell cell is higher than that of the zinc and since the zinc electrode manifests the lowest electrical potential, though highest chemical potential, we ought to use the minus sign when speaking of the electrical potential difference $Zn/ZnSO_4$.—Extract from a paper read before the American Electrochemical Society, May 3, 1918.

Electrochemistry and Batteries

Electrolytic Behavior of Manganese in Sulphate Solutions.—G. D. VAN ARSDALE and C. G. MAIER.—Manganese may be deposited at the cathode from neutral solutions with a high-current efficiency of 80 to 90 per cent and at pressures of 3 volts upward. The effect of increase of acidity is practically to prevent the deposition of Mn at a concentration of 0.36 per cent free H_2SO_4. The deposit is powdery, and ordinary expedients for improving deposition do not result in an appreciable increased efficiency. MnO_2 may be deposited at the anode at nearly 100 per cent efficiency. The effect of acid is to decrease the efficiency in cold solutions, but on heating to 65 deg. or 75 deg. C. there is a lesser effect. MnO_2 may be deposited from warm acid solutions containing more than 5 per cent $MnSO_4$ in the form of a dense, black, lustrous film at current densities up to 25 amp. per square foot (275 amp. per sq. m.) with a high deposition efficiency. Impurities which are reducing agents cause a decrease in current efficiency in proportion to the amount present.—Extract from a paper read before the American Electrochemical Society, May 3, 1918.

Experimental Carbon Cell.—S. ALBERT REED.—A primary battery is described in which the electrolyte is fused borax containing manganese dioxide, the negative pole is broken carbon in contact with a graphite grid, while the positive poles are strips of gold foil. The air oxidizes the electrolyte in contact with the outer gold strips, while the carbon reduces the electrolyte inside. Mixtures of CO_2 and CO are produced at the anode. The emf. averages 0.8 volt with a temperature of 935 deg. to 990 deg. C.—Extract from a paper read before the American Electrochemical Society, May 3, 1918.

Calculation of Storage-Battery Capacities.—C. W. HAZELETT.—The development of a circular slide rule for calculating storage-battery capacities is discussed and methods of selecting the charging and finishing rates are suggested. The author points out that it is important that final voltages be standardized as a continuous function of the time rate of discharge in order that the critical point of sulphation shall not be exceeded and so that the drop of voltage in the cell due to sulphation shall be the same at the end of discharge regardless of the rate. In other words, it would be desirable to subtract from the practical final voltage used at the lowest current rates the drop in voltage due to a given time rate of discharge which cannot be attributed to sulphation. Good practice during many years of experience shows that 1.85 final volts per cell is entirely satisfactory at the lowest current rates.—Extract from a paper presented before American Electrochemical Society during its trip through the Southeast, May 3, 1918.

Units, Measurements and Instruments

Value of "g" in Engineering and Physical Work.—SANFORD A. MOSS.—The article deals with the gravitational factor in the following sequence: Standard value of g, accurate local values of g, actual values of g in the United States, the reduction of forces to standard values, the correction factor for latitudes in the United States, the correction factor for elevation, gravity in formulas including forces due to the earth's attraction, and an appendix giving a summary of methods of computing g.—*General Electric Review*, May, 1918.

Telegraphy, Telephony and Signals

Amplifiers in Telephony.—G. VALENSI.—The results obtained in the United States by the use of lamp amplifiers in long-distance telephony are reviewed, and the performance of these amplifiers, the different methods of using them, the types of relays and the modifications that the use of telephonic relays necessitate in a network are considered.—*Revue Générale de l'Electricité*, April 6, 1918.

Miscellaneous

Resistances for Starters and Controllers.—Methods of assembling resistance materials for starters and controllers are described in this article.—London *Electrical Review*, Feb. 1, 1918.

Neutral-Tint and Variable-Tint Screen.—E. KARRER.—Neutral-tint screens which have high transmission coefficients suitable for use in a compact photometer are described.—*Journal of Franklin Institute*, April, 1918.

Industrial Electric Heating.—E. A. HOLLOWAY, J. B. BLACK and E. B. WALTHALL.—Data dealing with applications of electric heating apparatus are embodied in this article.—*Journal of Electricity*, April 15, 1918.

Midland Railway Company's Electric Fleet.—Data are presented to show the results obtained by the Midland Railway Company in operating seventy-six electric vehicles for the collection and distribution of merchandise in London and provincial centers. The vehicles have been tested on three classes of work, (a) long-distance suburban business, (b) full direct loads, and (c) miscellaneous collection and delivery involving frequent calls. The loading was so organized that the vehicles were operated at the highest possible efficiency. The accompanying table gives the results obtained.—*Electric Vehicle*, March, 1918.

AVERAGE ANNUAL COST* OF MAINTAINING AND OPERATING ELECTRIC VEHICLES AVERAGING 10,000 MILES PER YEAR

	Ironclad-Exide Battery		Edison Battery		30-Cwt. Parcel Van	Average 15-Cwt. 5000 Miles
	2-Ton	3½-Ton	2-Ton	3½-Ton		
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Energy	33 10 0	45 0 0	42 0 0	56 0 0	25 0 0	11 10 0
Tires	22 10 0	32 0 0	22 10 0	32 0 0	16 5 0	6 8 0
Repairs	20 0 0	25 0 0	20 0 0	25 0 0	16 0 0	9 11 0
Maintenance, including battery attention	11 0 0	12 0 0	10 0 0	11 0 0	4 6 0	4 6 0
Oil and stores	2 0 0	2 0 0	2 0 0	2 0 0	1 5 0	1 5 0
Standing charges	140 0 0	165 0 0	125 0 0	156 0 0	102 0 0	63 0 0
Total	£239 0 0	£281 0 0	£221 10 0	£282 0 0	£164 16 0	£96 0 0
Cost per mile	5.73d.	6.74d.	5.3d.	6.76d.	3.95d	4.61d

*Exclusive of drivers' and attendants' wages.

Book Reviews

THE PETROLEUM AND NATURAL-GAS REGISTER. Published by the *Oil Trade Journal*, 120 Broadway, New York City. 548 pages. Price, $12.

This is a comprehensive directory of the petroleum and natural-gas industries, co-ordinating the various branches of the oil trade in the United States, Canada and Mexico. Names of officers, capital stock, location of properties and other valuable data are given.

INDUSTRIAL RESEARCH IN THE UNITED STATES OF AMERICA. No. 1 of a series of papers under the title "Science and Industry" and bearing on industrial research. By A. P. M. Fleming. London: Department of Scientific and Industrial Research of the British Government. 60 pages. Price, 1s.

We are wont in this country to complain about a lack of research facilities, but looking over this pamphlet one cannot help being proud of the quality and quantity of the research institutions and laboratories which, according to Mr. Fleming, exist in the United States. One feels that the author not only desires to give specific information to his British readers, but also intends to hold up this country as an example for them to follow. He divides industrial research into five groups: (1) Research applied to the elimination of manufacturing troubles; (2) research having some new and specific commercial object; (3) researches in pure science with no specific commercial application in view; (4) research applied to public service; (5) research for the purpose of establishing standard methods of testing and standard specifications connected with the purchase of raw materials. Some of the features of the research work of the laboratories connected with American industrial manufacturing corporations that impressed the author most forcibly are: (1) The installation in many cases of full-scale manufacturing facilities, which makes it possible to relieve the works of experimental developments and also gives the laboratory staff first-hand knowledge of the complexities of actual manufacture; (2) the growing tendency to devote more and more of the resources of the laboratories to pure science investigations with a view to making discoveries; (3) the growing appreciation of men with scientific training not only in the research laboratory, where such training is essential, but also in regular manufacturing employment; (4) the value of research laboratories as a means of inspiring confidence in the minds of customers and as an effective advertisement; (5) the employment of the laboratories by financiers for the purpose of ascertaining the merits of new industrial propositions of which the value has not been commercially established. The author describes the research laboratories of some twenty leading American manufacturers and their associations and also has chapters devoted to research work done by colleges, national institutions, private laboratories, etc. The last chapters are devoted to the selection and training of research men, co-ordination and distribution of scientific data, and the relation of research to the capitalist, the manufacturer and the educator. In the final chapter of the book the possible schemes for a better organization of industrial research in Great Britain are discussed. The book is profusely illustrated with photographs and will be read with interest by those interested in the actual status of industrial research in this country. It affords the additional advantage of seeing ourselves as others see us.

RADIO COMMUNICATION, THEORY AND METHODS, WITH AN APPENDIX ON TRANSMISSION OVER WIRES. By John Mills. New York: McGraw-Hill Book Company, Inc. 205 pages, 120 illustrations. Price, $1.75 net.

This little red textbook is particularly useful in supplying much needed information for electrical engineers concerning the characteristics of vacuum tubes. In recent years and months there have been developed in a few special radio laboratories certain new vacuum-tube receivers, transmitters, oscillators, amplifiers and detectors; so that a particular branch of electric signal engineering that might be called vacuum-tube engineering has come into existence, with the manifest intention of staying and growing. This volume deals with the physical characteristics of these tubes in a quantitative way which appeals to the student. The book is also a pioneer in advancing the algebraic theory of oscillating-current circuits. The fundamental theorems of this type of circuit have already been propounded, but very few applications have hitherto appeared in textbooks. The method of presentation may not please every reader, however. The chapters of the book are devoted respectively to the following topics: Alternating currents, the telephone receiver, the vacuum tube, detection of high-frequency currents, production of damped sinusoidal currents, production of undamped high-frequency currents, radio-telegraphy and radio-telephony, practical appliances and methods of radio-telegraphy, transmission over wire circuits, and problems. The book will be useful to students of radio-telegraphy and radio-telephony.

Books Received

AIRCRAFT IN WARFARE. By F. W. Lanchester. New York: D. Appleton & Company. 222 pages, illustrated.

THE LANGUAGE OF COLOR. By M. Luckiesh. New York: Dodd, Mead & Company. 281 pages. Price, $2.50.

ANNUAIRE POUR L'AN 1918. Published by the Bureau of Longitudes. Paris: Gauthier-Villars et Cie. Price, 2 francs.

POWDERED COAL AS FUEL. By C. F. Herington. New York: D. Van Nostrand Company. 211 pages, 77 illustrations. Price, $3.

POWER WIRING DIAGRAMS. A Handbook of Connection Diagrams of Control and Protective Systems for Industrial Plants. By A. T. Dover. New York: Whittaker & Company. 208 pages, 254 illustrations. Price, $2.25.

THEORY AND OPERATION OF DIRECT-CURRENT MACHINERY. Prepared in the Extension Division of the University of Wisconsin. By C. M. Jansky. New York: McGraw-Hill Book Company, Inc. 285 pages, 214 illustrations. Price, $2.50.

THE CALORIFIC POWER OF FUELS. With a Collection of Auxiliary Tables and Tables Showing the Heat of Combustion of Fuels, Solid, Liquid and Gaseous. By Herman Poole. New York: John Wiley & Sons. 267 pages, illustrated. Price, $3.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

USE OF ELECTRICITY IN PROPULSION OF SHIPS

W. L. R. Emmet Comments on London Cable Concerning Electrically Propelled Merchant Ship Construction in England—Our Great Progress

London cable advices published in the newspapers this week state: "The first electrically propelled merchant ship ever built in England and the largest electric vessel in the world is now undergoing its finishing touches at a British shipyard and will soon start on its first voyage."

The ELECTRICAL WORLD asked W. L. R. Emmet, consulting engineer General Electric Company, to comment on the foregoing. Mr. Emmet says:

"I had seen the paragraph which you quote, but know very little concerning it. Some time ago an electrically driven ship installation on a vessel called the Mjolner was made by Ljungstrom in Sweden, and later a number of such installations were planned. I do not know how many of these have been completed in Sweden, but I have been informed that rights for Ljungstrom designs were taken up in England some time ago and that electrically propelled ships with machinery built after his method were contemplated. I presume that this paragraph relates to one of these.

"I feel pretty sure that the statement that this is the largest electrically propelled vessel must be erroneous. The United States collier Jupiter, equipped with electric propelling machinery designed by me, was put into commission in February, 1914. The Jupiter is 542 ft. long and of 20,000 tons displacement; her propelling machinery develops normally 7000 shaft horsepower and can be operated at considerably larger power.

"The United States battleship New Mexico, of 32,000 tons displacement and 36,500 shaft horsepower, has just been completed at the New York Navy Yard and will make her trial trip within a few days. In addition to these, we have contracts for electric propelling machinery for three other battleships of similar size and power, the California, the West Virginia and the Maryland. We also have contracts for machinery for three battle cruisers of 32,000 tons displacement and 180,000 shaft horsepower each.

"In addition to this machinery for the navy, we are building electric propelling machinery for two cargo boats which are being built by the Pennsylvania Shipbuilding Company. Each of these equipments delivers 3000 shaft horsepower.

"Some of the ship equipments are by far the largest electrical applications ever made. Each of the eight motors on one of the battle cruisers has four times the capacity of the largest motor previously built."

An article by Mr. Emmet, published in the ELECTRICAL WORLD of Jan. 6, 1917, gives general information concerning battle-cruiser installations, and a paper in the *Proceedings* of the Society of Naval Architects and Marine Engineers for 1915 also discusses the advantages of electric drive for large warships.

FUEL ADMINISTRATIVE ENGINEER FOR PITTSBURGH

Thomas R. Brown Appointed by Federal Fuel Administration—Policy to Be Extended to All States and Districts

The Federal Fuel Administration has announced the appointment of Thomas R. Brown of Pittsburgh as administrative engineer for the Pittsburgh district. C. P. Billing has been appointed his first assistant.

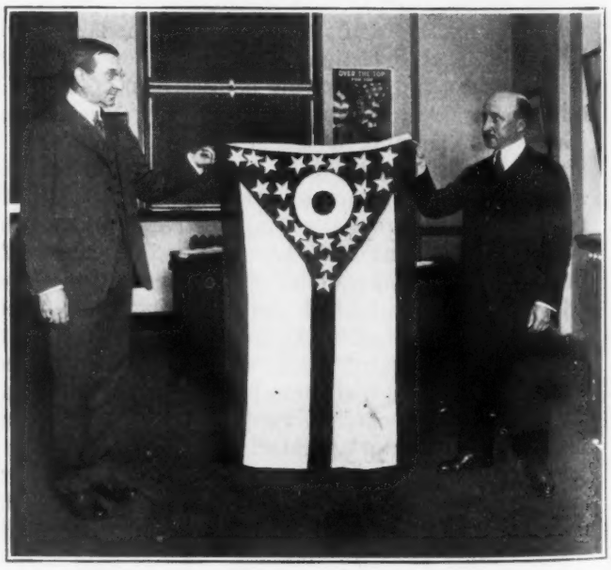
These appointments were made as a preliminary step toward putting into operation a general plan for fuel conservation in power plants. It is expected that the Pittsburgh experiment will serve as a model for other states and districts and that the total saving in the country at large as a result of the movement will be between 25,000,000 and 50,000,000 tons of coal.

A personal inspection is to be made of every plant.

Classification and rating of every power plant will be based upon the thoroughness with which owners conform to the recommendations of the Fuel Administration on generation and use of power, heat and light.

An administrative engineer is to be placed in charge of the work in every state and district. It will be one of his duties to rate the plant upon information received from inspectors.

An Achievement for the Third Liberty Loan



George DeB. Greene, chairman advisory trades committee, presenting twenty-one-star honor flag to Theodore Beran, chairman electrical industries committee for Greater New York, which exceeded the quota by 1000 per cent.

PURPOSE OF THE TEST IN ELECTRIC WELDING FOR SHIPS

Extension of Electric Welding to Major Part of Shipbuilding Will, It Is Hoped, Show Economy in Time and Money

A report of the purposes and possible benefits of the ship-welding test now being conducted by the Emergency Fleet Corporation at the Federal Shipbuilding Company plant at Newark, N. J., under the direction of Arthur J. Mason, has been made to Charles Piez, vice-president of the corporation. The part which the committee headed by Prof. Comfort A. Adams as chairman has in this work was outlined in the ELECTRICAL WORLD of March 3, 1918, page 683.

REPORT ON SCOPE OF CONTEMPLATED WORK

The text of Mr. Mason's report follows in part:

The committee of which Prof. C. A. Adams is chairman has been enlarged and is active in bringing to bear all the knowledge and apparatus available.

Electric welding in its various phases has for years been employed in shipyards and in the arts generally, but for a number of reasons the work has been confined to odd jobs and repairs. The proposal to extend its use to the major part of ship construction has met with gratifying approval from the shipbuilder. It remains for us through this large test to demonstrate its economy in time and money and its adequacy to build a stanch ship.

The purpose of this test is to demonstrate these advantages—to do it in such a way that all may see and contribute, and finally to test the structure itself so completely that there will follow a heart-whole and unanimous belief in the method.

The test itself will take the form of building part of a hull at the Federal Shipbuilding Company's plant, Newark, N. J.

It has been necessary to design a ship to suit the material available, without encroaching on that needed for the regular ship construction at the plant. This has been done. The hull will have the outline, dimensions and strength conforming to the ships the Federal company is building.

It has been thought best to conduct the work at a site apart from the shipways, so as not to interfere with that program.

A 10,000-ton ship, costing $2,000,000, now costs but $70,000 to rivet. It must be plain that if electric welding only promises to modify this amount no very substantial gain offers.

Splendid benefits we all feel do offer themselves in the possible change in the whole régime of shipbuilding. Our test has in view abolishing or greatly diminishing:

1. The railroad journey from rolling mill to fabricating plant, when the latter is not at the shipyard.
2. The templet makers' work.
3. The markers' work.
4. The punching.
5. Much of the work of the fitters and bolters who flog and pull the pieces to fit on the ways. There lies in the above items an excellent likelihood to save a month's time in construction and a saving of no less than $40 a ton in the cost of steel structure, at least $100,000 a hull on a 10,000-ton vessel.

Briefly the program is to assemble a hull rapidly by spot welding, tacking the ship together much as a tailor bastes his work in assembling a suit of clothes. The structure then becomes a house favorable for work in all weather and at night in which the completion of the ship may go on.

After the material is thus assembled and fastened with spot welds, so that it is sufficiently strong to hold its shape, the work is completed by arc welding all seams to insure strength and render the work watertight. Roughly we expect the spot welds to be about 10 in. (25.4 cm.) apart.

The preparation of the site is well under way; the pile driving will be completed within ten days. The severe tests of strength contemplated needed about 300 piles.

One quarter of the structure will be riveted, the other three-fourths welded, so that the tests of strength will afford a basis of comparison.

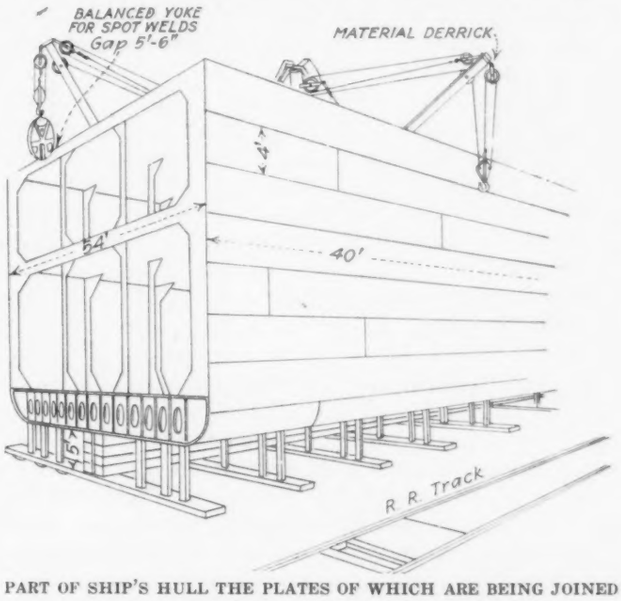
Electric welding offers a great field for lightening a ship. In this design various views of this opportunity will be tried out. The field here is very great—ultimately 10 per cent of the steel may be eliminated.

One derrick will bring material, the other derrick support the spot-welding yoke, whose function is to tack the material together, fastening the plates either to the frames or to the adjoining plates.

If one visits the ways at any shipyard, it becomes obvious that at any instant only a modicum of the men are for the moment at work. This is unavoidable under the present system. We hope to establish a plan of assembly with more continuity and less waiting on one another.

Only a fifth of the men on a hull are riveters. The spot-weld yoke will forthwith pull the parts to place with a much more vigorous agency than flogging and pulling to place by numerous bolts, now done by the other four-fifths.

The problems of fitting in place the parts of a hull are almost wholly problems arising out of the necessity to make



PART OF SHIP'S HULL THE PLATES OF WHICH ARE BEING JOINED PARTLY BY RIVETING AND PARTLY BY WELDING

a number of little holes in a plate made by one man at one time and place fit a number of little holes made by another man at another time and another place.

Once all holes are left out of the material, all parts fit. The creeping and kindred problems so perplexing to the shipbuilder disappear. Every plate becomes a closer. Every plate justifies itself.

The manufacture of the spot-welding yoke and appliances is placed in the hands of the Universal Electric Welding Company of Long Island City. The design of the yoke is completed, the patterns are made and steel castings will be forthcoming in the next ten days. The early stages of the arc welding are to be accomplished by the Wilson Electric Company, which was so successful in the work on the German ships' repairs, but it is the intention to call in all men with ideas and apparatus and to give them a field to test out in actual work. To this end Professor Adams' committee is searching out all available talent.

An adequate system of testing the work when done is under consideration. The primary test will consist of filling the hull with water and shifting the points of support under continual and close scrutiny, as one-quarter of the whole will be riveted in the normal manner. There will be always a gage of comparison between this portion and the portion which is welded.

Likewise there will be a chance for comparison of the two forms when subjected to abuse by bumping with rams and in various other ways.

It is a pleasure to report on the strong interest and ready help extended by the Federal ship people, whose plant and organization we are using for the purpose.

ELECTRIC BRASS FURNACES DISCUSSED BY OHIO MEN

This and Other Topics Form the Program of Final Meeting of New-Business Co-operations Committee at Cleveland

The industrial power and heating section of the new-business co-operations committee of the Ohio Electric Light Association held its final meeting in the rooms of the Electrical League of Cleveland on May 8. Mathias Turner, assistant general manager of the Cleveland Electric Illuminating Company, welcomed the delegates. The first paper, "The Present Status of the Electric Brass Furnace," was presented by H. M. St. John, research engineer of the Commonwealth Edison Company, Chicago. The positive and negative features of this type of electric installation were ably brought out, and an interesting discussion was led by F. F. Bailey, president Electric Furnace Company, and E. F. Collins, manager industrial heating engineering department of the General Electric Company.

Judge Vickery of the Common Pleas Court delivered a patriotic address at the luncheon, following which, at the afternoon session, two papers were presented—"Motor Hook-Ups, a Comparison of the Methods of Silent Chain Belts and Gears," by Paul V. Wheeler, engineer drive chain department, Link Belt Company, Cleveland, and "War-Time Economies," by W. A. Wolls, new-business manager Columbus Railway, Power & Light Company.

ELECTRICITY AT THE HOG ISLAND SHIPYARD

At Boston Banquet W. H. Blood, Jr., Speaks of Large Quantity of Electrical Machinery and Material Required

The importance of engineering service in relation to war work was the keynote of the ninth annual banquet of the engineering profession at the Boston (Mass.) City Club April 30. C. M. Spofford, president of the Boston Society of Civil Engineers, presided, and James W. Rollins of Boston officiated as toastmaster. Among the speakers were Alfred D. Flinn, secretary of the Engineering Council, New York; Major-General Harry F. Hodges, U. S. A., commandant at Camp Devens, Mass.; H. O. Westendarp, General Electric Company, Boston; Mayor Andrew J. Peters of Boston, and W. H. Blood, Jr., American International Shipbuilding Corporation, Philadelphia, Pa. All the speakers recognized the necessity for co-operation among engineers for war service and their value in military and naval tasks.

The chief address of the evening, by Mr. Blood, was an illustrated talk upon the development of the Hog Island shipyard. In the course of his remarks the speaker touched upon the large quantity of electrical machinery and material required at Hog Island, said to be the largest shipyard in the world. This included the installation of 3,000,000 ft. of wire, 40,000 electric lamps, 650 motors, a telephone exchange of 12,000 stations, and a connected load of 41,000 hp. supplied by the service of the Philadelphia Electric Company. At present the yard is 70 per cent completed; about $10,000,000 per month is being expended on its construction, and eleven ships have been started, of a total of 240 to be constructed as soon as possible, all of the fabricated steel type. Mr. Blood emphasized the importance of being able to contract for central-station service in this case, some 30,000 hp. having been set aside at Philadelphia for this great plant, where there was not enough time in which to build a local station for the yard, even had the latter been desirable. During the evening the need was emphasized of engineers for certain branches of naval service to supervise the actual construction of anti-submarine devices developed by American physicists. About 300 engineers attended.

CANADIAN NIAGARA POWER POOLED FOR WAR PURPOSES

Steam Plants of Toronto Electric Light Company and Other Corporations to Be Operated to Speed Munitions Output

A Canadian order-in-council provides virtually for the pooling of Niagara power on the Canadian side of the border. Sir Henry Drayton, the Dominion Power Controller, has also made arrangements with the Toronto Electric Light Company, the London Electric Company, Ltd., and other companies whereby those corporations will resume operation of steam-power plants. The power will be at the disposition of the authorities until the needs of munitions and other essential industries are met.

It is reported that Sir Henry Drayton received assurances in Washington that sufficient coal would be made available without reduction of the allotment of coal to Canada.

Canadian officials in charge of the control of power and fuel have indicated in public statements that in all probability further restrictions will have to be placed on the use of light, power and coal by non-essential industries, merchants, storekeepers and private citizens.

It was also stated by the power and fuel control officials that people must expect to suffer some inconvenience from coal shortage next winter.

"DON'T BE IMPATIENT, BILL, YOU'RE GOING TO FEEL IT"
—Columbus (Ohio) Dispatch.

AMERICAN ELECTROCHEMICAL SOCIETY AT HOTEL TUTWILER, BIRMINGHAM, ALA.

ELECTROCHEMISTS FINISH THEIR TOUR IN THE SOUTH

Government's Nitrate Plants at Muscle Shoals, on the Tennessee, Are Inspected, and a Technical Session Is Held in Birmingham

The American Electrochemical Society completed its tour of Southern industrial centers with visits to Sheffield (Muscle Shoals), Birmingham and Anniston, Ala. Particular interest centered in the inspection of the government nitrate plants at Sheffield. One of these is to make use of the modified Haber ammonia process and the other of the cyanamide process. The final product of both plants will be ammonium nitrate. Plant No. 1, using the ammonia process, will have a capacity of 200,000 lb. of nitric acid per day and plant No. 2, using the cyanamide process, will have ten times the capacity of the first. In connection with plant No. 2, the Air Nitrates Corporation, which is directed by officers of the American Cyanamid Company, has been confronted with the problem of building and governing a city as well as constructing the technical plant. Thirteen thousand men are now employed.

LUNCHEON FEATURES AND TECHNICAL SESSION

As guests of the local committees at Sheffield, the party was taken to Lock 6 on the Muscle Shoals canal of the Tennessee River, where a barbecue dinner was served and a number of addresses were delivered explaining the proposed hydroelectric developments at Muscle Shoals, on the Tennessee River. Returning to Florence by boat, an informal reception was held at the Elks' Hall. At Birmingham on the following day the entire party was taken by automobile to the Ensley iron and steel plant, Tennessee Coal, Iron & Railroad Company, and later to Bayview Reservoir, where a barbecue lunch was served. Later in the day the new steel-plate plant at Fairfield was visited. This plant is being constructed especially for the manufacture of ship plates.

The technical session was held in the evening at the Hotel Tutwiler, Birmingham, following a complimentary dinner.

The final day of the tour was spent at Anniston, visiting the plants of the Southern Manganese Corporation and Anniston Steel Company. The former is manufacturing ferromanganese in the electric furnace, and the latter is making electric pig iron from scrap. These two plants are the largest electric furnace developments in the South.

FACTORY LIGHTING CODE OF STATE OF WISCONSIN

Industrial Commission to Make Rules Effective July 1 on New Work and Give Two Years to Bring Existing Work Up to Standard

Work on the factory lighting code of the Industrial Commission of Wisconsin has progressed to such a stage that it is now expected to make it effective on new work after July 1, 1918. If this plan is carried out, existing installations will be required to be brought up to specification within two years after that date.

As the code now stands it makes adequate lighting mandatory. Intensities at the work are specified. The code gives data on what the commission will require as minimum intensities and also gives higher intensities as "recommended practice." These data are based on practice that has been found satisfactory. In its studies the engineering force of the commission has been able to bring out data to show that increased production has resulted from the installation of adequate lighting. Other features of the code are that it makes a provision against glare and also one for uniform distribution. Maintenance of lighting systems is provided for.

CONSERVATION OF TIN IS NECESSARY AS WAR MEASURE

General War Service Committee of the Electrical Manufacturing Industry Warns Manufacturers of Danger from Shortage

A bulletin to electrical manufacturers, issued by the General War Service Committee of the Electrical Manufacturing Industry, contains a warning to conserve tin. Stating that the government has assumed control of the importation and distribution of tin, the committee adds: "Demand is made that the use of tin cease for all non-essential purposes and be reduced elsewhere to the minimum consistent with the production of material and apparatus which will function safely and satisfactorily."

If electrical manufacturers are to obtain their supply of tin, the committee says, it will be necessary for every one to economize to the fullest extent possible.

Suggestions are made for reduction in the consumption of tin to the necessary minimum. "The war needs of our industry in this respect are fundamental," the committee concludes, "consequently your immediate, active co-operation is of vital importance."

GOVERNOR OF MAINE ON WATER POWER CONDITIONS

Governor Milliken Tells "Electrical World" that He Favors Development—Wants Investigation and Constructive Public Policy

Proposed state ownership of water-power developments in Maine has reached a snag in Governor Milliken's firm decision to call no extra session of the Legislature to consider this subject, it was learned last week at Portland. At the Republican state convention in Portland in March Representative Baxter tried to further the cause of public ownership along the Ontario plan, but the proposition fell flat in face of the heavy cost of public development, especially under war conditions. There seems to be no general demand for an extra session at this time.

Speaking of the water-power situation to a representative of the ELECTRICAL WORLD, Governor Milliken said:

"A rapid and complete investigation of the whole subject of water-power development, leading to a constructive public policy, is of vital importance at this time. The value of water power as a great natural resource is emphasized by the present uncertainty and scarcity of the fuel supply. Discussion of the problem of development is important and exceedingly timely. So far as existing laws give us authority, we are compiling information regarding Maine's water-power resources with some attention to cost of development. The next Legislature should provide sufficient funds to insure a prompt and exhaustive report."

The Governor believes that the State should retain its water-power within its own borders for the use and benefit of its own people, this having been the settled policy of the Republican party within the State since 1909. The ELECTRICAL WORLD is in a position to state, however, that the opinion is taking form in Maine that the exportation of surplus hydroelectric power, when available, should be permitted, in view of the economic advantages of interconnection among transmission systems. Governor Milliken fears the exploitation of Maine water powers for their own profit by interests outside the State, and said:

"It is argued against this policy that it delays development. The same argument was made years ago in regard to Maine's timber lands, and in the pursuit of supposed progress that valuable birthright was lost to the people of the State. It is better to develop our water powers slowly than to lose them altogether. It is my belief that all new charters of power companies should contain a clause forbidding the transmission of power outside the State without the express consent of the Legislature and that every existing power company asking for an amendment to its charter at any session of the Legislature should have this amendment added also.

"I will not approve any new water-power charter nor any material amendment to an existing charter without the addition of this clause. Within the State it is our plain duty to encourage the development of water power under conditions that will assure its availability for industrial and household use at reasonable rates without injustice to capital honestly and prudently invested in such projects."

The Governor is keenly aware of the economic value of water power as brought out by the coal crisis of last winter. Already Maine has the highest per capita water-power development in the country and stands third among the states of the Union in total development. He is anxious to have the subject opened up to the fullest possible extent.

There is little doubt, in view of the coal shortage in the Northeastern States last winter, that water-power matters will receive a good deal of attention at the coming biennial session of the Legislature in 1919. At the last session the movement to sanction exportation of power attained considerable headway, and it seems likely that the issue will again be raised. Among the operating companies there is a tendency to favor exportation at least of surplus power, with interconnection and the possibilities of interchange during periods of non-coincident low water. It was ascertained last

GOV. CARL E. MILLIKEN

week that the federal government is studying the possibilities of interconnection among transmission and hydroelectric systems along the borders of Maine and New Hampshire as a war measure to meet any power shortage or unfavorable water conditions on adjacent streams in adjoining states. The power requirements of shipyard and munition plants are large in the aggregate, and the whole subject is tied in so closely with fuel conservation that it is a most vital one at this time.

INVESTIGATION OF WATER POWER BY MAINE PUBLIC UTILITIES COMMISSION

Through the courtesy of Judge B. F. Cleaves, chairman of the Maine Public Utilities Commission, the ELECTRICAL WORLD is permitted to outline the plans of the board for a special investigation of water powers, existing and potential, in the principal river basins of Maine.

This investigation will be conducted by the engineering department of the commission under the direction of its chief, Paul L. Bean, and is to be assembled in a report to the next Legislature. The investigation will be in four parts—first, a study of the principal rivers; second, a comprehensive treatment of the cost and selling price of steam, oil-engine and hydroelectric power; third, a survey of power uses and markets; fourth, the legal aspects of water-power development.

The river study, of particular interest to hydraulic

engineers, will cover such main topics as the determination of power at developed and undeveloped sites, determination of storage sites, increase in the economic capacity of Maine rivers and total power in the State developed and undeveloped. Under the second division the report will cover the cost of power from different types of prime movers, the relatively low cost of unit power by developing storage, the cost of electricity for lighting and power as shown by comparisons of contracts and rates, and the detailed cost of power production, including operating expenses and fixed charges. This section will be of special interest to bankers. The power market section, with emphasis upon Maine uses, will be of great interest to the layman, and the legal section will contain much valuable material on water-power rights.

This investigation, of course, will not exhaust the subject, and the need of appropriations to carry the study further and especially into the field of smaller powers will be clear at the coming session of the Legislature.

WATER-POWER CONTROVERSY IS BEING WAGED IN MAINE

Campaign Against State Ownership Is Begun, and the Claims of Its Advocates Are Vigorously Attacked in the Newspapers

To offset the agitation for the public ownership of water powers which has lately been revived in Maine, a vigorous publicity campaign has been opened in the representative newspapers under the auspices of most of the leading electrical utilities of the State. William M. Pennell of Portland has been retained to conduct the campaign, which is already attracting widespread interest.

In the first publicity matter of the campaign, printed as a signed advertisement, attention is called to the claim of the public ownership advocates (headed by Representative Baxter of Portland) that 1,500,000 hp. of water power is going to waste in the State and that most of this formerly belonged to the State. Emphasis is laid upon the fact that a great number of these sites were owned by individuals long before Maine became a state. The State never had any ownership in the powers on the Saco or Presumpscott River. Its holdings on the Androscoggin, if any, were confined to the upper waters near the Rangeley Lakes. On the Kennebec the State owned no powers south of Madison, and on the Penobscot no powers were ever owned by the State within 50 miles north of Bangor. The only powers the State could claim any interest in were those situated in the so-called "wild lands" district. When the State sold these lands it conveyed title to the powers therein. Several times in many instances these power have been conveyed, and the Supreme Court has established the validity of the titles.

Advocates of state ownership claim that the inadequacy of water-power development by private capital resulted in much unnecessary suffering by industries and by the general public during the period of fuel shortage last winter. As a matter of fact there were fewer shutdowns in Maine resulting from coal shortage than in almost any other state of the Union. For example, the mills of Lewiston and Auburn, with one exception, were able to run because of hydroelectric power. This condition obtained at Bath, a large shipbuilding center; at Portland, where ships and munitions are being produced; at Westbrook, Sanford, Waterville, Skowhegan, Biddeford, Saco and other manufacturing centers where the mills were unhampered by the coal situation except in the matter of heating.

The contention of the public ownership advocates that the development of water powers under private control has been very slow during the last seven years is being vigorously denied by the utilities. During the last seven years the Azischos dam has been completed on the Magalloway River, storing 9,500,000,000 cu ft. (266,000,000 cu. m.) of water and increasing the minimum flow of the Androscoggin River more than 100 per cent. The cost of this development was $1,000,000. On the west branch of the Penobscot River the Ripogenus dam has been built, impounding 22,000,000,000 cu. ft. (616,000,000 cu. m.) of water, and thus adding greatly to the efficiency of all the water powers on that stream. The cost of this development was over $1,000,000. These two developments will generate when needed more than 40,000 hp.

At Rumford Falls there is being developed added power to the amount of 18,000 hp. and at a cost of over $1,000,000. On the Saco River during the past seven years there have been completed two of the largest developments on the river, viz., at Bonny Eagle and at Hiram, where the present installation of waterwheels equals 16,000 hp., with a reserve when needed of 4000 hp., at a cost of $2,000,000. At Grand Falls, on the St. Croix River, there has been developed by the St. Croix Paper Company 8000 hp., with an added reserve capacity of 4000 hp. The expenditure at this development was more than $1,000,000. At Oakland the Central Maine Power Company is developing 3000 hp., and during the last seven years it has expended $3,500,000 in increasing the capacity and the efficiency of its plants. The Portland & Lewiston Interurban Railroad, using the surplus power of the Androscoggin Electric Company, was built and placed in operation during the last seven years at a cost of more than $1,000,000. A total of over 90,000 hp. has been developed during the last seven years, instead of less than 50,000 hp., as asserted by the public ownership advocates. But for the war conditions a 14,000-hp. development would also have been made at Clark's Rips, on the Androscoggin River, a task which will be performed as soon as normal conditions again obtain.

One of the contentions of the advocates of public ownership in Maine is that there is enough undeveloped water power to heat and light a large percentage of the homes of the State by electricity. The utilities are criticised by these interests as being behind the times in regard to the development of house heating by hydroelectric energy. The rejoinder of the utility companies points out that a residence burning 10 tons of coal for heating would consume about 60,000 kw.-hr., and at a price of from 1 cent to 3 cents per kilowatt-hour the cost would therefore be from $600 to $1,800 for the period. Tests have shown that it requires at least 13.5 kw. to warm a dwelling of six rooms. There are probably 160,000 dwellings in Maine averaging six rooms each, and if all the undeveloped power which could be developed in the State were used to heat houses only, there still would not be sufficient energy to heat one-fourth of these dwellings.

Home-Made "Tank" Central Station's Liberty Loan Parade Feature

In the recent parade on behalf of the third Liberty loan at Portland, Me., the Cumberland County Power & Light Company made a decided hit by contributing an imitation "tank" to the pageant. The "tank" was designed by H. J. Howarth, superintendent of the meter department and L. G. Scott, superintendent of underground construction.

WAR POWER PROBLEMS MET BY CALIFORNIA COMMISSION

Necessary Construction Recommended to Conserve Fuel Oil and Assure Further Development of Hydroelectric Resources

The California Railroad Commission has rendered a decision in the matter of the construction and operation of electric utilities during the emergency created by the war, as applied to the transmission and sale of power from the California-Oregon Power Company and the Northern California Power Company to the Pacific Gas & Electric Company. The commission has fixed the following rates for power to be delivered:

California-Oregon Power Company—Delivery to Northern California Power Company at Kennet.

Guaranteed delivery and purchase, 8500 kw. at 70 per cent load factor, equivalent to 52,122,000 kw.-hr. a year.

Rate (3.75 mills a kilowatt-hour) a year, $195,500.

Energy delivered in excess of 8500 kw.-hr. at 70 per cent load factor, 52,122,000 kw-hr.

Rate, 2.75 mills a kilowatt-hour.

California-Oregon Power Company and Northern California Power Company—Delivery to Pacific Gas & Electric Company at Colusa.

Guaranteed delivery and purchase, 8000 kw. at 70 per cent load factor, equivalent to 49,056,000 kw.-hr. a year.

Rate (4.9 mills a kilowatt-hour) a year, $240,000.

Guaranteed purchase of maximum of 4000 kw. additional on a basis of 50 per cent annual load factor, based upon the average peak available supply throughout the year at Colusa in excess of 8000 kw.

Rate: All additional energy in excess of 70 per cent guaranteed load factor on 8000 kw., 3.5 mills per kw.-hr.

It is also recommended: that the California-Oregon Power Company and the Northern California Power Company enter into agreements for the transmission and delivery to the Northern California Power Company of 8500 kw. at Kennet; that the California-Oregon Power Company, the Pacific Gas & Electric Company and the Northern California Power Company enter into agreements for the transmission and delivery to the Pacific Gas & Electric Company at Colusa of 8000 kw., together with excess power as set forth in the commission's decision and according to the rates fixed for the delivery.

It is further recommended that the several companies take immediate steps to conclude such agreements or contracts and to construct the transmission lines and substations required for the delivery and utilization of such power at the earliest time commensurate with economy of construction.

The investigation in general was instituted by the Railroad Commission on its own motion to determine the special needs of electric utilities in the war crisis and to enable the commission to render prompt service to the government, the utilities and the public so that there should be no shortage or interruption of service to industries.

The investigation so far made has been directed principally to the matter of the conservation of fuel oil and the further development of hydroelectric power on the part of the electric utilities to prevent any shortage of power.

Five Large Companies Serve Territory

More than a month ago the commission made recommendations as to conditions in the southern part of the State for certain interconnections and other improvements to meet growing requirements. The five larger companies serving in central and northern California are the Pacific Gas & Electric Company, the Great Western Power Company, the Sierra & San Francisco Power Company, the Western States Gas & Electric Company and the Northern California Power Company. These five companies generate practically all the hydroelectric power produced and sold in that territory.

The decision says:

The investigation made and the evidence presented in this case show that there is a shortage of hydroelectric power in the central part of the State; that none of the electric utilities have in progress of construction hydroelectric plants to meet the demand for power, which is increasing at an annual rate of approximately 25,000 kw. of demand and 150,000,000 kw-hr. a year; that during the coming season less hydroelectric power will be produced than normally, due to the shortage in precipitation, and that all practicable means should be taken to conserve fuel oil and meet the necessary demands for power and thus not hamper the industries during the war.

Considering the continually decreasing oil storage in California and the threatened shortage which may occur, it behooves the electric utilities to do all that they reasonably can to keep their consumption down to a minimum, and assistance should be given to them in so far as practicable to increase the utilization of existing hydroelectric facilities and the further development of plants as soon as this is possible.

Investigations in connection with this matter show that the California Power Company has completed a hydroelectric plant known as Copco, near the California-Oregon line, with a capacity of 10,000 kw., which is not at present needed for the local requirements of that company, and further, that the Northern California Company has a surplus capacity of approximately 4000 kw. during the seven months of the year from October to April inclusive. Provided the companies can finance the required transmission facilities to deliver this power to the Pacific Gas & Electric Company, this additional power, representing approximately 60,000,000 kw.-hr. a year, delivered to the Pacific company could be made useful in meeting the growing requirements for power in the bay districts and reduce the oil requirements approximately 240,000 barrels a year.

Various plans were proposed to make use of this power, but on account of financial difficulties and rate controversies these were not accepted. Finally the following proposals were arrived at, on recommendations made by L. S. Ready, acting gas and electrical engineer of the Railroad Commission:

1. The California-Oregon Power Company to reinforce and reconstruct its transmission line from Copco to Costella and construct a 70,000-volt line from Costella to Kennet of sufficient capacity to transmit to the Northern California Power Company at Kennet 8500 kw. Estimated cost, $330,000.

2. The California-Oregon Power Company to finance the Northern California Power Company to the extent required to reinforce that company's lines from Coleman to near Hamilton by the addition of No. 0 copper conductor to the west line so that there can be delivered thorughout the year to the Pacific Gas & Electric Company at Colusa 8000 kw. Estimated cost, $110,000.

3. The Pacific company to construct a 60,000-volt transmission line of sufficient capacity from Colusa Corners, near Colusa, to Drum-Cordelia. Estimated cost, $440,000. A 100,000-volt line and install a substation of 12,000 kw. rating, from 60,000 volts to 100,000 volts, to deliver the power into that line. Estimated cost, $200,000. Total estimated cost, $640,000.

The Pacific company will be required to re-route the power from certain of its existing plants over its Wise-Stockton Mission-San José line to the southern district. This line is under construction at the present time and will be completed by the time power can be delivered at Colusa.

A general understanding was reached as the result of conferences as to the amount of power to be delivered and purchased, as follows:

1. The California-Oregon company is to guarantee to deliver at Kennet to the Northern California company, and the latter company to agree to take for transmission south, 8500 kw. at 70 per cent load factor.

2. The California-Oregon company and the Northern California company are to agree to deliver to the Pacific company at Colusa Corners 8000 kw. at 70 per cent load factor throughout the year.

3. The Northern California company is to agree to deliver to the Pacific company during the months of October to April inclusive 4000 kw. at 50 per cent seasonal load factor.

4. The Pacific company is to agree to purchase and take from the Northern company a minimum of 8000 kw. at 70 per cent load factor for twelve months and 4000 kw. at 50 per cent seasonal load factor for the seven months.

5. The agreements were to be incorporated in a contract to run for ten years, with the right to apply for change of rate in five years. It was further understood that the Northern California Power Company's delivery of power to the Pacific company at Chico, under contract relations, should in no way be affected by this contract.

The result of the above agreement, if carried out, will be the purchase by the Pacific company of a minimum of 59,000,000 kw.-hr. a year. This will represent an oil conservation of approximately 240,000 barrels a year.

SALE AND PURCHASE PROVISIONS

Under the proposed rates and agreements of sale and purchase, the California-Oregon company is to deliver to the Northern California company at Kennet a minimum of 52,122,000 kw.-hr. a year, equivalent to 8500 kw. of 70 per cent load factor, for $195,000, and for energy supplied in excess of that amount to receive payment at the rate of 3.75 mills a kilowatt-hour. This power is to be transmitted by the Northern California company to the Pacific company at Colusa, where it is to be delivered at the minimum of 8000 kw. of 70 per cent load factor, equivalent to 49,056,000 kw.-hr. a year, for an annual payment of $240,000. In addition to this amount, the Northern California company agrees to deliver the surplus power to a maximum of 4000 kw. to the Pacific company, and the Pacific company agrees to purchase that power at a load factor based upon the average available peak of 50 per cent. All power purchased in addition to the minimum guarantee of 49,056,000 kw.-hr. to be at a rate of 3.50 mills a kilowatt-hour. Under this proposed agreement there should be delivered to the Pacific company at Colusa a minimum of 60,000,000 kw.-hr. a year, which will represent an oil conservation of at least 240,000 barrels a year.

OPERATING CONDITIONS OF SAN FRANCISCO COMPANY

Heavy Loss in Net Operating Revenue of Pacific Gas & Electric Company Due to Operating Expenses

At the recent annual stockholders' meeting of the Pacific Gas & Electric Company John A. Britton pointed out that the reason for the heavy loss in net operating revenue last year lies in the operating expenses of all departments. There was an increase in the maintenance of properties over 1916 of $82,000, in operation of $1,613,863, and in taxes and administrative expense of $349,939, or a total increased expense of $2,045,808 against increased revenue of only $1,197,883.

In the electric department the average revenue per consumer in 1916 was $56.54 as against $55.87 in 1917. The electric construction costs during the year were $853,041 net, or $61.20 per consumer obtained. The cost per kilowatt-hour, including generation by water and steam, was 1.81 mills in 1916 and 2.55 mills in 1917, an increase of 0.74 mill. The increase in oil costs alone would have amounted to 0.76 mill, or more than the total increase, economies in other ways reducing the net loss to 0.74 mill.

The average of operating and maintenance expenses per kilowatt-hour increased from 6.9 mills in 1916 to 7.3 mills in 1917, an increase of 0.4 mill. In this time the cost of oil increased 0.89 mill per kilowatt-hour, showing that a compensating decrease in expenses had been made. Oil prices and water shortage, Mr. Britton pointed out, were responsible for the entire increased cost. The ratio of average load to plant capacity in 1916 was 53 per cent as against 46 per cent in 1917. This reflects the shortage of stored water and affected 74,000,000 kw.-hr., having a value in oil of $500,000.

Reference was made to the 15,000-kw. turbine for Station "A" in San Francisco, which is to be delivered about the first of next year, and to the possibility of a tie-in with the California-Oregon and Northern California Power Companies. These improvements to the system will cost approximately $2,000,000. With these extensions, Mr. Britton said, all demands on the system that may be deemed by the government of a necessary character could be met.

Workmen injured in the course of their employment in 1917 numbered 673, and the average cost per employee was $8.53, as against $9.34 in 1916. The cost of these accidents was less than one-half of 1 per cent of the year's gross earnings, while if casualty and compensation insurance had been carried, the cost would have been approximately $225,000, or 1.4 per cent. The total number of accidents to employees and other persons was 1908, a decrease of 351 over the previous year.

To Speed Aircraft Production

JOHN D. RYAN

John D. Ryan, president of the Montana Power Company and the Anaconda Copper Mining Company, has been appointed, Secretary of War Baker announces, director of aircraft production for the army.

THE LARGER PROBLEMS OF OUR FOREIGN TRADE

M. A. Oudin Discusses "American Economic Interests in the Asiatic East" at Fifth National Foreign Trade Convention

An address on "American Economic Interests in the Asiatic East" was made by M. A. Oudin, manager foreign department, General Electric Company, before the Fifth National Foreign Trade Convention, Cincinnati, last month. Some of the remarks of Mr. Oudin, who has been in the East recently, follow:

America is not represented abroad by capital investments commensurate with her wealth. It is a problem in our foreign trade to find a sufficient number of Americans typical of our best home elements who are willing to live outside the United States and to make the furthering of our export trade their life's vocation. The consequence is that the American colonies in many foreign countries are small in numbers and constantly changing but relatively effective in developing markets for our products.

We must not blind ourselves to the fact that the pressure of economic necessity is the cause of nearly all wars. The present war is no exception. Precipitated by Germany in the expectation of extending its commercial opportunities, it has developed into a mad and desperate struggle on the part of that country for position—political, military and territorial—which with the coming of peace will enable its possessor to fasten its grip upon the world. So far the gainers have been the Central Powers, through their control of Belgium, parts of France, Russia, the Balkans, Roumania and the Transcaucasus. All the warring nations, except the United States, are purposely striving either to make or to retain a place for themselves in the economic sun. And this they are doing notwithstanding that they are engaged in a life and death struggle and that those who are fighting on European battlefields are spending billions of dollars and suffering an appalling sacrifice in lives.

In the United States there is a disposition to push aside all problems except the vitally important one of how to win the war. We are confident of the unselfishness of our motives and the disinterestedness of our aims. But no one can predict how far these policies and these principles will prevail at the peace conference. These principles must be backed up by more than a conviction on our part of their high moral character, by more than powerful naval and military forces. We will invite embarrassment if we do not take stock of our economic and industrial and of our agricultural and mineral resources. We will court disaster if we unduly delay taking the necessary constructive measures for the improvement of our economic position. It is certain that at the peace table a knowledge of the exact state of our resources and those of our Allies and the possession of a strongly fortified economic position will be trump cards. They will help us secure a better peace for ourselves and for the world, in which our rôle is that of a leader of democratic peoples.

The maintenance after the war of the relative commercial opportunities of the nations as they existed at its commencement may help to postpone a future war by removing one of the principal causes of war. For the time being, however, the power of might rules in the world and no one can say for how much longer it will continue to do so.

There never was a greater need for sagacious and cautious statesmanship and for an enlightened public knowledge of world politics than in the present crisis of our country. So long as our people are unaccustomed to think in international terms, American interests will be frequently set aside for a supposedly greater gain in some other and less material direction. There should be, in addition to this wider public interest in international affairs, a closer co-operation between our administrators and the people, or at least those of our citizens who are specialists in these matters. It is not too much to urge that our business men study world politics and world economics in order to arrive at sound opinions upon all questions internal as well as external which influence our interests overseas; next, that labor realize to what an unexpected extent its welfare depends upon a steady and permanent outlet for the product of its efforts, which may be insured by an extensive foreign commerce, and lastly, that the government of the United States, following the example of all of the other great commercial nations, freely seek out and confer with those of its citizens who, because of their special knowledge and experience, are qualified to give expert advice on the complicated questions involved in our international relations.

MR. FARRELL ON FUTURE TRADE CONDITIONS

In his address James A. Farrell, president National Foreign Trade Council and president United States Steel Corporation, made the following forecast of conditions after the war:

There can hardly be a question that for a good many years after peace is restored the rehabilitation of the vast territory wasted by the war and the replacement in neutral countries of equipment which has necessarily suffered from deterioration while replacements have been impossible will provide a large outlet for surplus production.

Whatever may be the eventual terms of peace, one conclusion would seem to be reasonably certain: We and our allies will have sacrificed our blood and treasure in vain if we have not succeeded in insuring hereafter conditions of peace under which we shall be free to carry on our domestic and foreign commerce without the fear of military dictation.

Gerard Swope, vice-president Western Electric Company, spoke at the convention on the best form of co-operation in the export field.

At a luncheon of the American Manufacturers' Export Association held at Cincinnati in connection with the convention E. M. Herr, president Westinghouse Electric & Manufacturing Company, said:

"We are facing as serious and critical a situation in our foreign trade, especially our foreign trade in manufactured products, as the nation faced at the sinking of the Lusitania, and are doing almost as little toward real preparation for the proper development of this trade as we did as a nation at that time in preparation for the terrible war in which we are now engaged."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Synchronous Club, Los Angeles.—At the May 2 meeting J. M. Lee of the Los Angeles Bureau of Light and Power spoke on "Prime-Mover Economics."

International Association of Municipal Electricians.—The annual convention of the International Association of Municipal Electricians will be held at Atlanta, Ga., on Sept. 24 to 27.

Arkansas Association of Public Utility Operators.—The annual convention of the Arkansas Association of Public Utility Operators will be held at the Arlington Hotel, Hot Springs, Ark., May 21, 22 and 23.

San Francisco Electrical Development League.—At the May 1 meeting of this organization W. L. Goodwin outlined the plans which are being developed for organizing all branches of the electrical industry on a national scale.

Engineers' Society of Milwaukee.—N. J. Whelan, industrial commissioner, and V. S. Hillyer, construction engineer, of the Wisconsin-Minnesota Light & Power Company of Eau Claire, Wis., gave an illustrated lecture on the Wissota dam before the Engineers' Society of Milwaukee on May 8.

Joint Engineers Hold Meeting in Chicago.—At a joint meeting of the American Institute of Electrical Engineers, the Western Society of Engineers and the American Society of Mechanical Engineers in Chicago C. F. Kittering, president of the Society of Automotive Engineers, gave an interesting address on the "Automobile Power Plant."

A. I. E. E., Pittsburgh Section.—The May meeting of the Pittsburgh Section of the American Institute of Electrical Engineers will be held May 14 at the Chamber of Commerce auditorium. Dr. E. E. Sparks, president of the Pennsylvania State College, will present a paper on "Present Problems of Technical Education." This paper deals especially with army work.

Southwestern Electrical and Gas Association.—At the fourteenth annual convention of the Southwestern Electrical and Gas Association, a report of which was published in the May 4 issue of the ELECTRICAL WORLD, it was decided to hold local meetings of the three sections three times a year in different cities and so arrange these meetings that members near these cities can attend with small expenditure of time and money.

Wisconsin Association of Electrical Contractors and Dealers.—The need of co-operation between industries, the government and the public were emphasized by Burton Williams, internal collector of revenue for the Wisconsin district, in an address at the banquet of the Wisconsin State Association of Electrical Contractors and Dealers held recently in Madison. Among the important papers presented at the two-day convention was one on "Selling Electrical Appliances on the Installment Plan," by R. B. Snyder, general sales manager for the Milwaukee Electric Railway & Light Company.

Joint Committee of Technical Societies of Southern California.—George A. Damon of Pasadena was elected chairman and W. K. Barnard of Alhambra secretary at a recent meeting of the Joint Committee of Technical Societies of Southern California in Los Angeles. This organization contains members of the branches of seven national engineering societies in southern California in one body of more than 1000 electrical men. The membership includes architects, electrical, civil, chemical, mining and mechanical engineers.

State Factory Inspectors.—At meetings of state factory inspectors of Pennsylvania and New Jersey recently Prof. C. E. Clewell of the University of Pennsylvania gave lectures on the "Specification of Quantity of Light," "Relation of Glare to Factory Lighting" and "Distribution of Light in Factory Spaces." The addresses dwelt upon the importance of quantity of light and emphasized various other important factors. The necessity of taking into account physiological as well as physical requirements, the allowance for the worst conditions, excessive variations of daylight and the practical measurement of quantity of illumination were also discussed. At one of the meetings G. H. Stickney, president of the Illuminating Engineering Society, outlined the various efforts which have led to the formation of factory lighting codes and the present status of such codes throughout the United States.

O. E. L. A. Transmission and Distribution Committee.—At the last conference of the season for the transmission and distribution men of Ohio, which was held at Youngstown recently, various Pennsylvania as well as Ohio companies were represented. R. R. Krammes of the Central Ohio Power Company presided at the meeting and introduced V. E. Goodwin, lightning-arrester engineer of the General Electric Company, Pittsfield, Mass., who gave an interesting address on "Protection of Electrical Apparatus Against Lightning." Mr. Goodwin answered various questions as to the operation and construction of the various forms of arresters, including the electrolytic arrester. In the discussion of Mr. Goodwin's paper it was brought out that the present form of electrolytic arrester is the best form of available protection against lightning. Another paper, "Overhead Crossings of Electric Light and Power Lines for Voltages Greater than 10,000 Volts," was read by M. H. Wagner, transmission and distribution engineer of the Dayton (Ohio) Power & Light Company. It showed that exacting and abnormal clearances are required by some railroads.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Negligence in Injury to Property.—A light and power company was liable for breaking a plate-glass window while installing a light if the damage was the proximate result of its negligence or that of its servants within the scope of their duties, not contributed to by negligence of plaintiff or its servants, it was held by the Court of Appeals of Alabama in Birmingham Railway, Light & Power Company vs. E. & W. Dry Cleaning Company (77 S. 922).

Loss of Profits Is the Damages Resulting from Cutting Off Current.—The true standard or test for determining the loss resulting from the impairment of a business by a cause readily remediable, as by the wrongful discontinuance of electric energy during eight months or less, primarily is not depreciation in rental value of the building occupied, the occupany thereof not otherwise being disturbed, but rather loss of profits of the business therein conducted because of the interruption of the energy, the Supreme Court of West Virginia held, in Chambers vs. Spruce Lighting Company (95 S.E. 192).

Damages Collectible if Service Is Not Furnished When Promised.—A municipal corporation authorized by law to sue and be sued, contract and be contracted with, acquire, hold, possess and dispose of property, and to provide for the lighting of streets and furnishing the city or town and the inhabitants therewith with gas or other lights, as well as to allow the use of streets and alleys of the city to any person or corporation who might desire to establish works for supplying the city and its inhabitants with water or lights upon such reasonable terms as the council should prescribe, granted defendant corporation a franchise to erect poles and string wires in the streets of the town, the ordinance requiring defendant to give a bond conditioned that it should have a certain portion of its service in full operation within nine months after the grant of the franchise and should maintain it so as to furnish electricity adequate for light and power purposes. Defendant accepted the terms of the grant and accepted and executed its bonds, but failed to erect poles or in any way to comply with the requirement that it should have a certain percentage of its service in full operation within nine months. It was held by the Supreme Court of Oregon in City of Grants Pass vs. Rogue River Public Service Corporation (171 P. 400) that the municipality might without proof of any special or actual damages recover the amount of the undertaking.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

California Commission Expense.—The expense of conducting the California Railroad Commission is less than one-tenth of 1 per cent of the revenue of the utilities regulated by it.

Bureau of Mines Needs Trained Men.—Important chemical and other technical engineering work necessary for the prosecution of this war is being carried on by the Bureau of Mines experiment station at Washington, D. C. The services of trained men of several classifications, including electrical engineers, are urgently needed.

Denver's Committee on Safety and Efficiency.—One of the innovations of the Denver Gas & Electric Light Company is the committee on safety and efficiency, presided over by T. O. Kennedy, general superintendent, which meets monthly to listen to suggestions from all departments. A prize for the best suggestion is awarded. H. P. Tewksbury was a recent winner, his suggestion being that all departments be ordered to observe rigid economy in the use of electricity and gas for the further conservation of fuel.

Increased Rates at Fond du Lac.—The Railroad Commission of Wisconsin has rendered a decision in the application of the Eastern Wisconsin Electric Company to increase its electric rates at Fond du Lac. The company requested authority to apply a surcharge of 1½ cents per kilowatt-hour to all lighting and power bills, including bills for street lighting. The decision of the commission authorized a surcharge of ½ cent per kilowatt-hour to be applied against all lighting and power business for six months, beginning May 1.

Lighting Lectures Delivered to Pennsylvania and New Jersey Factory Inspectors.—The committee on lighting legislation of the Illuminating Engineering Society, under the chairmanship of L. B. Marks, has drafted and issued a code of factory lighting which has been used as a guide in the preparation of the codes of Pennsylvania and New Jersey. To promote a better understanding of the fundamental principles of the factory lighting codes now in force in these two states, the department of electrical engineering of the University of Pennsylvania, of which Harold Pender is professor in charge, co-operating with the State Labor Departments of Pennsylvania and New Jersey, arranged a series of lectures covering two all-day sessions for April 25 and May 9. Visiting inspectors were invited to look into the various laboratories of the electrical engineering department between the lecture sessions or to visit other buildings on the university campus.

Samuel Insull Speaks at Rockford.—Samuel Insull, president of the Commonwealth Edison Company and chairman of the State Council of Defense for Illinois, spoke before the Rockford (Ill.) Chamber of Commerce on April 24. During his stay in Rockford he also visited the National Army cantonment at Rockford, where he was conducted over the camps for an inspection of each of them by Gen. O. H. Martin and Lieut. Jack Eddy.

Large Turbine Overhauled After Long Run.—The Commonwealth Edison Company recently took down for inspection and overhauling its unit No. 3 at Northwest station. This unit is a 30,000-kw., 25-cycle General Electric compound unit. This was the first overhauling the unit had received since it originally went into service two and one-half years ago. It is interesting to know that during this length of time the machine generated 475,000,000 kw.-hr.

Cincinnati Rate Case.—City Solicitor Saul Zielonka of Cincinnati, Ohio, is seeking before the Ohio State Supreme Court to prevent the Public Utilities Commission from exercising jurisdiction in the electric light rate controversy. Mr. Zielonka had been notified by the commission that a decision on his motion to strike from its files the application of the Union Gas & Electric Company for a modification of the order fixing 8½ cents as the rate for Cincinnati would be withheld until after the hearing on the application. This motion raised the question of jurisdiction, and this is the reason for the appeal to the Supreme Court. The order for the 8½-cent rate was issued after the city and the company had agreed upon it, and the city solicitor contends that the rate should be binding under this agreement for the term of the ordinance, five years.

Priority in Kansas City, Mo.—The first denial of priority instructions on equipment for the Kansas City Light & Power Company new central station has occurred with reference to its turbines. It is believed in Kansas City that the denial is tentative. Since information regarding it has been received in Kansas City nearly all the large industrial plants using energy have written to the Washington authorities urging that the company be allowed to complete its plant, as their need for more energy is imperative. All of those which wrote are on "short rations" of energy, and nearly all are in one way or another in war commodity production, including mills, steel and iron working plants and plants making actual munitions or accessories to army equipment. Several plants which had planned their schedule of production with the expectation of getting electrical power within the year also represented their situation to the board. Erection of the company's central station is temporarily held up awaiting adjustment of labor difficulties. The company will complete all details so far as possible whether the turbines are released meanwhile or not, but a renewal of the priority order is of great importance.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rates Found Too Low in Wisconsin.—Approving an increase in electric rates of the Cross Plains Electric Company, the Wisconsin Railroad Commission shows that analysis of the applicant's earnings and expenses indicates that for the year ended June 30, 1917, it failed to earn more than 5.3 per cent on its estimated value, and that the elimination of receipts from sale of fixtures, wiring, etc., would wipe out entirely the surplus available for returns during such year; that under the circumstances an increase in rates is justified. The company testified that it was losing money on farm consumers, owing to transformer losses. The greater percentage of profits has been from house wiring and sale of fixtures, a business it is no longer engaged in. In general, it was losing money because its light and power rates were too low in proportion to the cost of doing business. The commission authorized a new schedule of rates, which includes rates for commercial and street lighting, power service, rural service, and a penalty for failure to pay bills within ten days of date of bill.

Company Should Justify Higher Rates.—In declining an application of the Electric Light & Power Company of Burns for authority to increase rates, the Oregon Public Service Commission says: "In our opinion the market for electric energy in Burns will produce, under rates no higher than those now in effect and under conditions of adequate service and careful management, a return more reasonable in proportion to the investment necessary for such service than that now received. A request for an advance in rates is unreasonable and should not be considered until such time as the applicant can come before this commission and show clearly that it has made necessary provision to insure its patrons adequate service and that every possible opportunity has been accepted for increasing the revenue of the company by the development of such profitable business as may be available within the territory served by it. . . . Patrons display utter lack of confidence in the devices used for the measurement of the energy consumed, and the management itself does not by proper test or inspection keep itself sufficiently assured of the accuracy of this equipment in order that it may restore such confidence or defend its charges. In these and other respects the business methods of the management of this company are lax to such an extent as to eliminate the possibility of co-operation from the public."

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Richard Eick has been promoted to the position of general agent of the Little Rock Railway & Electric Company.

Prof. Louis Vessot King of McGill University, Montreal, has been awarded by the Franklin Institute its Howard N. Potts medal for his improved method and researches in hot-wire anemometry.

C. C. Turley, for ten years manager at Vancouver, Wash., for the Portland Railway, Light & Power Company, has resigned to accept a position with the Utah Power Company at Salt Lake City.

William Marconi has been awarded the Franklin medal by the Franklin Institute. The medal will be presented on May 15 to Count V. Macchi de Cellere, representing the Italian government, for transmission to Mr. Marconi.

W. L. Davis, until recently a traveling auditor on the staff of the American Power & Light Company of New York City, has been appointed auditor of the Lehigh Valley Transit Company, the Lehigh Valley Light & Power Company and affiliated companies at Allentown, Pa.

Prof. Thomas Corwin Mendenhall, physicist, former president of Worcester Polytechnic Institute and a United States delegate to the International Electrical Congress in 1893, has been awarded the Franklin medal by the Franklin Institute. The medal will be presented on May 15.

E. C. Vickers, assistant manager at Duquoin, Ill., has been promoted to the position of district manager of the Eldorado group of properties of the Saline Electric Company, a subsidiary of the Southern Illinois Light & Power Company, to fill the vacancy caused by the resignation of F. T. Morrissey.

Dr. A. E. Kennelly, acting head of the electrical engineering department of the Massachusetts Institute of Technology, has been awarded by the Franklin Institute its Howard N. Potts gold medal for his invention of the hot-wire anemometer and his application of this device to the measurement of convection from small heated wires.

O. W. Jones, commercial manager of the Texas Power & Light Company of Waco, Tex., has been transferred to Cleburne, Tex., as manager of the Cleburne district. Mr. Jones went with the company late in 1916, prior to that having been engineer of distribution of the Columbus (Ohio) Railway, Light & Power Company and later superintendent of the meter and distribution department of that company.

O. S. Maple, formerly purchasing assistant of the United States Shipping Board, Emergency Fleet Corporation, at Washington, D. C., has recently been appointed assistant purchasing officer of that corporation. Mr. Maple was formerly engineer on steam-plant design for the Fargo Engineering Company, Jackson, Mich. He joined this concern in the fall of 1916, going from the Texas Power & Light Company, for which he was assistant construction engineer.

R. A. MacGregor has resigned as sales manager of the Merchants' Heat & Light Company, Indianapolis, to accept a position as sales engineer for the Lakewood Engineering Company of Cleveland in its Pittsburgh territory. Mr. MacGregor has become well known in the central-station industry through his connection since 1900 with such companies as the West Penn Company at Connellsville, Pa.; the C. H. Geist Company, Plymouth, Pa., and Chicago; the H. L. Doherty Company, New York, and the Connersville (Ind.) Light, Heat & Power Company. In the service of H. L. Doherty & Company, as sales manager of the Empire District Electric Company at Joplin, Mo., Mr. MacGregor and his sales force at one time made a record of closing 22,000 hp. of electric service in twenty months. As sales manager of the Merchants' Heat & Light Company he had charge of the construction and equipment of the company's appliance store, known as the "Daylight Corner," which is well known in the central-station trade as one of the modern electrical merchandise salesrooms of the Middle West.

R. A. MACGREGOR

Albert M. Grall, Webb City, Mo., representative of the new-business department of the Empire District Electric Company, has been made new-business manager of the Ashland (Ohio) Gas & Electric Company.

Jefferson L. Alexander, for many years superintendent of the lighting department of the Savannah (Ga.) Electric Company, has been transferred by the Stone & Webster Management Association to a similar position with the El Paso (Tex.) Electric Company.

R. E. Brown has been appointed commercial manager of the Little Rock (Ark.) Railway & Electric Company to succeed A. E. Smith.

W. R. Sammons, formerly of the commercial department of the Knoxville (Tenn.) Railway & Light Company, has succeeded G. H. Smart as commercial manager.

J. F. Owens, vice-president and general manager of the Oklahoma Gas & Electric Company, who, as announced in the ELECTRICAL WORLD for May 4, was elected president of the Oklahoma Gas, Electric and Street Railway Association, received his education in the University of Kansas and, after teaching for a few years, entered the utility business. He installed and managed the electric plant at Oswego, Kan., and then went to Oklahoma, where he installed the Wagoner plant and managed the property for three years. He then accepted the position of superintendent of the Caney River Gas Company, serving in that capacity for two years. In 1911 he became connected with the Byllesby interests as superintendent of the Muskogee Gas & Electric Company, being promoted in March, 1917, to the position of general manager of the Muskogee property. In March, 1918, he moved to Oklahoma City and was promoted to the position of vice-president and general manager of the consolidated Byllesby properties in Oklahoma.

Obituary

Charles F. Sise, founder of the Northern Electric Company of Canada, died on April 9. In 1879 he went to Canada for the purpose of organizing the telephone business of the Dominion on a national basis. For many years he was president of the Bell Telephone Company of Canada.

E. P. Warner, a pioneer in the field of commercial electrical design, died in Los Angeles recently, at the age of seventy-seven years. Mr. Warner was first engaged in the manufacture of telegraph apparatus. In 1872 he entered the employ of the Western Electric Company, retiring after thirty-eight years of service in 1910. For many years Mr. Warner was associated with the development of power apparatus and arc lights for the company. When he retired he was engaged in sales work.

Major Charles G. Baird, Signal Corps, U. S. A., reported dead from disease in Monday's casualty list from General Pershing, was the chief of the entire telephone and telegraphic service of the American Expeditionary Force in France. He entered the army immediately after Congress declared war on Germany and organized the 413th Telegraph Battalion, one of the first of the Signal Corps units ordered overseas. For a number of years Major Baird has been recognized as one of the leading experts in America on railroad signal equipment. He was thirty-eight years old.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

RESALE PRICE FIXING IS TO BE COMBATED

Recent Decision Establishes the Policy Which Will Henceforth Be Followed by the Federal Trade Commission

For a considerable time there has been a controversy throughout the country over the question of the right of manufacturers, wholesalers, etc., to fix resale prices at which their articles must be sold. The right to maintain such resale prices has been contended for by them, and the question whether such right exists has been brought before the Federal Trade Commission numerous times.

The Federal Trade Commission has just disposed of the first of the cases in which complaints have been issued charging violations of law through fixing the resale price of articles, and an order to cease and desist from this practice has been issued by it in the case of Chester, Kent & Company, Inc., of Boston, manufacturers of proprietary medicines.

Attorneys for the company admitted that in the past the practices complained of had been in use. The order, the first in cases of this character, forbids the company to (a) indicate to dealers the prices for which its proprietary or patent medicines shall be resold; (b) obtain agreements from dealers to adhere to such prices; (c) refuse to sell to dealers who fail to adhere to such prices; (d) refuse to sell to dealers who fail to adhere to such prices upon the same terms as dealers who do so adhere; (e) furnish any advantage to dealers who adhere to the resale prices while refusing similar treatment to dealers who do not adhere to the prices.

The Federal Trade Commission has made a statement saying:

"After full consideration the Federal Trade Commission has decided to issue complaints against all business concerns that refuse to sell unless the purchaser will agree to maintain a resale price fixed by the seller. The case just decided is the first formal finding by the commission to that effect. When once an article has passed from the maker to a purchaser he owns it, and the owner of such article may sell it at any price that he chooses provided he does not himself sell it at such price as to be below cost and thereby enter into unfair competition with other retailers selling the same article.

"This decision is going to be open to considerable controversy in relation to the subject matter thereof, and the matter will probably have to be settled by an act of Congress in the manner suggested by Mr. Justice Brandeis in his concurring opinion in the Supreme Court of the United States in the case of the American Graphophone Company. The Stephens bill which is now in Congress is in relation to that matter, but in the estimation of many business men and others it is thought to be broader than it should be. It may be that resale prices can be so regulated by placing somewhere power protecting against unfair prices as to make them work equitably and be a fair method of competition in commerce, but that question will undoubtedly have to be settled by Congressional action."

At almost the same time that this statement was made Judge Hand of the Federal District Court signed an order dissolving a combination alleged to have been created by the Victor Talking Machine Company. The complaint accused the Victor company of having entered into unlawful agreements with upward of 7000 dealers in various parts of the United States for the purpose of preventing competition, to limit the supply and to fix the prices of talking machines and records made by the defendant.

EFFECT OF THE WAR ON LAMP-BULB COMPOSITION

New Glass Has Many Advantages That Make for Speed in Manufacturing Besides Lowering the Cost of Production

As a result of the war a decided change in the making of glass bulbs for incandescent lamps has come about during the past year. This change, according to F. A. Poor of the Hygrade Lamp Company, Salem, Mass., will eventually result in the lowering of the cost of finished lamps. The importation of potash was stopped on account of the war, and to-day only a very small percentage of this material is used in lead-glass bulbs. Lime-glass bulbs have come into use as a substitute, the lime-glass bulb being made by automatic machinery instead of being blown by hand. The glass is also melted in large tanks, so that it is sometimes called tank glass, and this tends to reduce the cost of manufacture, since lead-glass bulbs are melted only in pots of small size.

Another advantage of lime glass is its softness and quicker speed of melting as compared with lead glass. In time this is likely to lead to faster production, and the light-green color is pleasing. The shrinkage has gradually been brought down from a maximum of 50 per cent to 15 to 30 per cent, depending upon the extent to which a factory substitutes lime glass for lead glass. The Hygrade company has found progressive improvement in shipments of lime glass. The practice of receiving lime-glass bulbs from the glass factories all cracked off will soon become standard, and this, with experience in handling the newer material, is likely to lead to decreased shrinkage and lower production cost throughout the usual range of commercial sizes.

NORTH AMERICAN GOODS IN SOUTH AMERICAN MARKET

Some Reasons Advanced Why Manufacturers in the United States Are Not Able to Compete with European Goods

That South America is a fruitful field for electrical goods is well known. It is equally well known that American goods have not sold in these southern republics as have European goods. An interesting sidelight on the reasons for American goods losing out in the competition for this market is given by Pedro Luis Gonzalez of Santiago, Chile, the editor of the Chilean government publication *Boletin de la Sociedad de Fomento Fabril*, which is probably the leading publication in Latin America devoted to industrial and commercial affairs. He said: "If there is one line of trade where American manufacturers and exporters would profit immensely by a genuine effort to comprehend the South American market, it is electrical specialties and electrical merchandise of all kinds. Latin America is not importing from the United States anything like the quantity of these goods it would do under different conditions, notwithstanding that our requirements are as great as or greater than they were prior to the war. This is simply and solely for the reason that American exporters have not seriously taken in hand the proposition as have the exporters of Great Britain and France, and as Germany formerly did and will do again when the war is over. I mean by that that these European manufacturers and exporters get close to the popular fancy of our people, and not only frequently

undersell the United States but make trading with them a satisfactory proposition all round.

"Then, again, better terms and prompter deliveries are to be considered. For several years past it has been the custom of the larger British and French exporters to keep at central points in South America fairly representative stocks of goods in warerooms, in charge of a manager with one or two salesmen. These stocks are being added to constantly and steadily replenished. The warehouses in nowise differ in purpose or in scope from the stock rooms of the home factory where the goods are produced. They do not sell to the retailer, but are for the purpose of keeping the wholesaler (or 'distributer,' as we call him) supplied. In some cases these stock rooms are not sole agencies of a single manufacturer, but several manufacturers in noncompeting lines of electrical specialties and general electrical equipment conduct them jointly, thus dividing the expense of maintenance.

"Now, contrast this way of doing business with that of the United States. If an order is placed with a United States manufacturer, the merchant must know just where to locate the manufacturer of the goods in the United States, the price and whether they are in stock for immediate shipment, wait twenty-three to thirty days for his order to reach the manufacturer and a like length of time for the shipment to reach him if the goods are shipped on the day the order is received (which frequently they are not), go through a troublesome routine of insurance, tariff and customs details, pay cash, risk loss from bad packing, and take the chance of finding, after all this delay and annoyance, that the goods sent are not in accordance with order."

METAL MARKET SITUATION

Conference with War Industries Board on Future Price of Copper—Rubber-Covered Wire Advances

A conference between the copper producing and refining interests and the War Industries Board was held in Washington, D. C., last week. The purpose was to have the official price for copper increased from 23.50 cents to 25 cents a pound.

There is a marked difference of opinion as to what action will be agreed upon regarding prices after June 1, when the present rate expires by limitation. Wire and cable manufacturers are inclined to believe a higher figure will be named; but there is strong opposition from those who are of the opinion that to change the existing schedule is unnecessary.

No Straits tin is being offered; a lone lot under urgent demand was sold at $1 a pound. No. 1 Chinese is selling at 95 cents to $1, and No. 3 at 91 cents, May shipment. A bill was passed by the House of Representatives last week placing tin under the control of the President, and a fixed price will doubtless be named when this bill becomes a law.

Nickel is down ten points and lead is softer. Changes in old metals are comparatively light.

NEW YORK METAL MARKET PRICES

	April 29	May 6
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
	Price per lb.	Price per lb.
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	26.25 to 26.75	26.25 to 26.75
Lead, trust price	7.00	7.00
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	Govt. price 15.00	Govt. price 15.00
Spelter, spot	6.85 to 6.90	7.10 to 7.12½
Tin, Chinese*	92.00	$1.00
Aluminum, 98 to 99 per cent.	Govt. price †3.10	Govt. price †32.10

OLD METALS

Heavy copper and wire	21.50 to 22.50	21.50 to 22.00
Brass, heavy	13.50 to 13.75	13.50 to 13.75
Brass, light	10.50 to 11.00	10.50 to 11.50
Lead, heavy	5.75 to 6.00	5.75 to 6.00
Zinc, old scrap	5.50 to 5.62½	5.50 to 5.62½

*No Straits offering. †In 50-ton lots; carload, 32 cents per lb.

THE WEEK IN TRADE

ALONG regular or commercial lines trade in the electrical industry at large is not so active. Government requirements seem to absorb the time and attention of prominent jobbing manufacturers, distributers and producers of everything electrical that is used or can be adapted to war purposes.

Freight embargoes still interfere greatly with the delivery of needed stock, and certain staples are reported as in the anticipated shortage stage. Conduit in many sizes continues to be low in supply, especially on the Pacific Coast and in the Northwest. Large industrial enterprises in these sections are absorbing vast quantities of electrical material, for which they are dependent on Eastern factories. The slow deliveries are hampering the trade.

Collections are reported very satisfactory, with credits closely scrutinized.

NEW YORK

Jobbers report business very good. Government orders continue heavy, but in almost every case where they are likely to tax the resources of jobbers on certain items they are distributed among the manufacturers direct by an official representative in every branch of the electrical field. Business of this kind is taken care of efficiently and prompt deliveries follow.

Shipping promises are hampered by embargoes, and certain lines are none too strong. Labor scarcity is a drawback that becomes more menacing and in the judgment of producers must inevitably affect the price of finished goods. Collections are reported to be particularly good in certain lines for April.

FUSES.—Standard inclosed fuses have been reduced 5 per cent. This is owing, it is alleged, to the sharp competition and increasing sale of the renewable fuse.

LAMPS.—In regular sizes manufacturers have about caught up with the demand. Special lamps, of unique design and lighting effects, are being offered the trade. They are making a favorable impression and large sales are prophesied by progressive jobbers.

COLLECTIONS AND CREDITS.—Several jobbers report collections as good and even better than for some time. This is said to be partly due to the prompt manner in which the government is meeting bills. Statements are now rendered net ten days, and cash discounts are suspended, jobbers being satisfied that settlements will be made. Credits are held in a firm grip.

MOTORS.—A Western manufacturer shipping into Eastern territory states that on single and polyphase motors of 25 hp. commercial deliveries are made in from two weeks to a month, sometimes better, depending on priority orders. On larger-size motors and transformers, 150-hp. rating, shipments are made in from twelve to fourteen weeks. Prices remain steady, but strikes at the plant and ever-recurring labor troubles of one kind or another, if continued, will affect the costs situation. Each order is individually treated, and no quotations are made unless authorized by the factory. This applies also to promises.

LAMP CORD.—An Eastern producer states that, since cotton is a speculative material and the cost is fluctuating widely, no one can safely predict what may be the price in the future. Unless the cotton market shall become stabilized an advance should be expected, particularly when the stock on hand and coming through at old prices is exhausted.

INSULATING TAPES.—The market has been advancing steadily for a year or more, four price increases having occurred within twelve months. The last advance of 10 per cent was made a month ago, responsive to the high cost.

of cotton cloths and also a higher price for oils and varnishes.

FANS.—With the carefully expressed opinion of several fan manufacturers which appeared in a recent issue of the ELECTRICAL WORLD, that a shortage was imminent, in mind, another producer of large facilities qualified the statement from his own point of view. He believed that if there were a shortage it would be in the Eastern States and New England. The West and Southwest are already amply provided, he asserted, and deliveries in many cases have already been accomplished. The only exception in making shipments, east and west bound, was from Philadelphia. Priority orders there seemed to him almost impossible, though no explanation was offered. However, the arrival of warm weather, the crucial test, might put a different complexion on the entire fan situation. A New York jobber is positive a scarcity will ensue, stating that the selling season has already opened, two months in advance of the usual time. A warm summer is anticipated and figured upon by dealers.

PORCELAIN.—Knobs and cleats are in fair supply, but shipments are held up at the principal factories by embargoes. Tubes are short. An advance of 3 to 7 cents apiece has been announced on Hubbell sockets and ceiling receptacles, effective as of May 1. Other manufacturers report that price increases were made on their products previously.

LAMP GUARDS.—An increase of 33 1/3 per cent has been made on Matthews lamp guards.

CHICAGO

Interest in the Liberty loan campaign in Chicago has not slowed up business to any greater extent than was expected. A good many of the men in the industry have been devoting the major portion of their time to the business of selling government bonds, but the trade has learned to expect this activity and to discount it in advance. Government buying of supplies is not as yet very heavy, but is constantly expected to grow. There is also a feeling that central stations will have to loosen up before long on purchases of certain classes. The real estate market here and there is beginning to show activity in the matter of groups of workingmen's cottages consisting of from 50 to 100 units. More of this business is to be expected as the war progresses. On the whole, the business continues about the same as to volume. The Sanitary District is in the market for a large bill of pumping equipment.

The building activity for the week ending May 1 amounted to 106 building permits, totaling $898,100. For last week 111 building permits were issued, totaling $630,600. For the same week last year 146 building permits were issued, amounting to $1,176,800. The electrical permits for the week of May 1 this year totaled 657. This included 7411 incandescent lamps and 1318 hp. Last week 671 permits were issued for 8362 incandescent lamps and 772 hp. For the same week last year 944 permits were issued.

COPPER WIRE.—Weatherproof wire has advanced to a 30-cent base. The increase of 2 cents was due to the rising price of cotton. Weatherproof is steady at this price.

CONDUIT.—The difficulty in getting the larger sizes still prevails.

PORCELAIN.—There is very little activity. Opinion in some quarters has it that something is about to happen in the porcelain market.

FANS.—Dealers outside of Chicago appear to be taking the jobbers' word for it that there will be a fan shortage this year, and a great many of the jobbers have their distributers signed up. In Chicago it appears that the retailers have a pretty fair stock left over from last season and are not so ready to take on new commitments as usual at this time.

INCANDESCENT LAMPS.—In the standard sizes the jobbers are pretty well caught up on stock. On the larger sizes and on the 220-volt lamps, however, shortages still exist.

BOSTON

Sales are holding up well this week, and the successful completion of the Liberty loan campaign is marked by good feeling in commercial circles. Collections are reasonably good, though credits are closely scrutinized in connection with new business. In most lines deliveries show some improvement, owing to better railroad conditions. Stocks are generally in excellent shape to meet present demands, with the exception of motors above 50 hp. in rating and the larger sizes of conduit. Appliances are moving well, and the market is oversold on one of the best makes of washing machines. Prices held steady throughout the week, with a tendency toward softness in the smaller sizes of copper wire on close competitive bidding, due to the lower price of cotton. The shortage of skilled labor is quite serious.

LAMPS.—Stocks are increasing locally in all except miniature sizes, which are in great demand for military and naval uses as well as for automobile and motorcycle service. Prices show no change. The factories are working hard to catch up with back orders, and considerable shipments have been added to local storage on the ordinary mercantile and commercial sizes. Orders keep up exceptionally well.

AUTOMOBILE BATTERIES AND STARTERS.—A boom is noted in these equipments with the rapid advance of the automobile season. Rebuilt cars are calling for much accessory apparatus of improved design, and it is hard to fill the current demands from local stocks; but it is being done, on the whole, very well. Prices continue steady.

SIGNALING SYSTEMS.—The low volume of new construction in building work has cut down the sales of telephone, signaling and annunciator systems materially to commercial buyers, and even the war-order plants are not installing interior telephone apparatus to a degree which offsets the lack of a normal market. Manufacturers of this type of equipment, however, are busy on special government orders. A shortage of skilled machinists is reported.

MOTORS.—Deliveries less than five months are still difficult to procure on motors of 50 hp. and upward, speaking generally. Stocks are increasing, on the whole, in the smaller motors, both alternating-current and direct-current. The demand seems to be decreasing slowly in the lower sizes, with prices still unchanged but subject to possible shading on resales if the present recession in small-motor consumption is long maintained.

STORAGE BATTERIES.—Distributers report continued heavy demands from the government and the automobile industry. The former dominates the factory output to-day, and labor shortage is seriously felt by the manufacturers. Deliveries cannot be made over the railroads fast enough to enable any sizable stocks to be accumulated. Prices hold firm, with little prospect of further advance in the near future

CONDUIT.—Stocks are spotty in range and total deliveries are very unsatisfactory, and government control of basic materials tends to shut out the ordinary consumer from getting even reasonably fair shipments. The first claim on conduit is held by the Emergency Fleet Corporation, the government's general war work holding the second.

PORCELAIN.—While it is difficult to build up local stocks, the manufacturers are gradually catching up on orders, and the situation is a little better than a few weeks ago. House-wiring business is at such a low ebb that other requirements can be filled more easily than were a vigorous policy of central-station business expansion under way. No immediate changes in price are anticipated.

WIRE AND CABLE.—Government orders almost monopolize the market, including among these all war-service work. Prices are firm, but in some cases it is understood that slight recessions of the order of ¼ cent per pound are quoted on small weatherproof wire with a relatively high cotton content in proportion to the metal constituent. No change in base prices has been noted as a result of the slump in cotton.

ATLANTA

Not all of the gains in business, where they appear, are in number and magnitude of transactions, and the distinction between volumes and values becomes more sharply defined as the rise in price along general lines continues. The steadily enhancing costs, together with financial difficulties, have a perceptible influence in repressing demands in not a few quarters. With the advancing season there has come an appreciable revival of activities in many directions, although the cold weather has militated against the best results in retail distribution. Residence and apartment construction in Atlanta and vicinity during the last two months shows up better than in the corresponding months of last year in face of less propitious general building conditions. A number of industrial concerns have been organized in the South the past week. The Lake Charles Naval Stores Company, Lake Charles, La., capitalized at $900,000, has taken over some valuable turpentine land in Louisiana. The Aluminum Company of America will erect a nitrate plant at Maryville, Tenn., costing approximately $2,000,000. Power will be transmitted from the new Algoa plant on the Little Tennessee River, about 45 miles south of Knoxville. Specifications call for completion of this plant by Sept. 1.

In small lighting plants the outlook is much brighter this week for plants from 50 kva. to 250 kva. While most of the inquiries noted are coming from municipalities, a sprinkling of private demand is observed. Manufacturers report increasing sales of late, running anywhere from $5,000 to $50,000. This business is being handled by local bankers. Prices on this class of equipment are up approximately 20 per cent over last year. Shipments are being made from five to six months.

POLE AND LINE MATERIAL.—Jobbers report substantial sales to the smaller municipal plants covering cross-arms, pins and the general list of material under this head. This material is being used mostly for replacement work. Turnbuckles have advanced 20 per cent. Deliveries on the whole are still poor on line material.

FLASHLAMPS.—The volume of sales as reported by dealers indicates an increasing demand. Stocks are in good condition.

DRY BATTERIES.—With the advent of more seasonable weather this week a decline in sales is noted. Local stocks have accumulated during the last few weeks. Jobbers' outstanding shipments are coming in more rapidly.

SCHEDULE MATERIAL.—A heavy business is reported from all quarters, with sporadic and spotty pressures from government sources for large quantities. As a rule stocks are in fair shape and well distributed.

CONDUIT.—An excellent market exists, with a corresponding low stock condition, some sizes being entirely out. A rumor is afloat that conduit is going to take a jump shortly.

RUBBER-COVERED WIRE.—The rumor regarding an increase for conduit holds good as well for wire. It has been stated from reliable sources that No. 14 single-braid is going to be very scarce and exceedingly hard to get two or three months from now.

SEATTLE

The volume of business transacted during the past week by Northwest electrical jobbers was exceedingly satisfactory and was equal to that of the past several weeks. No exceptionally large orders were placed. The bulk was with the shipyards, particularly steel yards in Seattle and Portland territories. Several districts report increased buying from wooden shipyards which recently secured additional contracts. The largest steel shipyard in Tacoma in operation plans enlarging the yard by seven ways.

The close of the third Liberty loan drive brought a reaction in retail business, particular animation being shown in increased activity and volume in this trade. The conduit market condition remains the same. Stocks are very low and the larger sizes are extremely hard to obtain. The apparent reason for shortages in wire, motors and certain types of lamps lies in uncertain shipments from Eastern factories. L. C. L. shipments are next to impossible to obtain. Several of the largest Seattle jobbers report the early arrival of shipments en route for the last sixty days. A Seattle car-building concern received an order for 14,000 box cars to be built for the government. It is assumed by West Coast lumbermen that fir will enter largely into the construction of this new rolling stock along the line of government plans to conserve steel. The effect of placing this order in the Northwest, calling for delivery at the earliest date, will be to strengthen the entire lumber market. Since the first of the year more than $3,500,000 has been invested in new buildings. In Seattle the large bulk of the building consists of bungalows and frame residences. Selling activity in the residence districts continues unabated. During the week one Seattle realty firm alone took out permits for the immediate erection of thirty-three homes in Tacoma. During April the number of building permits and the cash value represented were twice as large as for the same month last year.

Credits and collections are keeping pace with sales. Both were very satisfactory during April. The third Liberty loan drive among the jobbers had little if any effect on business, the comparison between business transacted in March and in April showing small difference. Both were heavy months, April perhaps being a shade heavier. Very few new credits are being placed, business transacted being merely an extension of credit to old-established customers, which is considered preferable to placing new business with new concerns whose business integrity has not been tested. Inquiries for credit from shipbuilding concerns awaiting sanction from the government before starting operations are coming in. Credits are being more closely scrutinized.

SAN FRANCISCO

During the past week there have been a number of inquiries for ship-wiring material, particularly for electrical hardware, such as bells, push-buttons and annunciators. These have been the outstanding features of a rather dull week. Among the building permits announced are those for a six-story building for the San Francisco Federal Reserve bank and announcement of the construction of an industrial city at Clyde, near Bay Point. The city of San Francisco is calling for bids for the construction of a new pier. The Bethlehem Steel Works announces a two-million-dollar plant at Hunters Point, on San Francisco Bay, and the United States Army will construct a four-hundred-thousand-dollar balloon camp near Arcadia. Canneries and suitable industrial housing still remain the principal building items. A number of churches are also under construction, and there is also some reconstruction for the southern California area shaken by earthquakes.

CONTROL DEVICES.—There is a large call for control devices for heavy motors and for industrial systems, especially for shipyards and ship control.

SWITCHES.—An unusual demand exists for big switches. The number of smaller knife switches sold is low because of the lack of house-wiring jobs and because power companies are not selling as many ranges as they did last year. Still the fact that the State of California is now employing inspectors to see that its safety laws are enforced will cause an ever-increasing demand, even though a large portion of prudent manufacturers have already complied with this law. Eastern shipments are fair and local stocks good.

ELECTRICAL INSTRUMENTS.—The demand for electrical measuring recording instruments, particularly for styles and sizes previously regarded as unusual, is so great that the Eastern factories cannot cope with it. Three to six months' delivery is the rule.

LAMP CORD.—For lamp cord, reinforced cord and other house-wiring styles there is little regular demand, but the shipbuilding industries are requiring vast quantities of deck cable, orders for 10,000 ft. or 25,000 ft. of a size being now regarded as quite regular. The underwriters' recommendation that "Mazda C" lamps of certain capacities be wired with asbestos insulated lamp cord has not been thoroughly enforced and is not causing the expected demand.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10% to 57.25
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10% to 66.75

Twin-Conductor

	No. 14 Solid
Less than coil	List to $104.00
Coil to 1000 ft	10% to $97.75
	No. 12 Solid
Less than coil	List to $135
Coil to 1000 ft	10% to $126.00

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%
	No. 12 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%

Twin-Conductor

	No. 14 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%
	No. 12 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10% to 24 cents
1/5 to std. pkg.	20% to 19 cents
Std. pkg.	34% to 18 cents

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+ 20% to 12%
1/5 to std. pkg.	List to 20%
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175-.3195	.3275-.3295
Barrel lots	.2875-.2895	.2975-.2995

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 100 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp...Net		15% to $69.75
3/8-in. d. stp.+10% to	75.00	List to 72.00
1/2-in. s. stp...List		15% to 93.00
1/2-in. d. stp.+10% to	100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.25-78.75	71.25-71.75
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$55.00	$20.50-$24.45	$20.00-$21.50
1/4-in.—	$28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$36.00-$55.00	$25.00	$22.50
1/4-in.—	$40.00-$60.00	$27.00	$25.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38 and 39

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 12%	7% to 15%
2500 to 5000 lb.	6% to 14%	9% to 17%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	5.3% to 8.9%	8.3% to 11.9%
2500-5000 lb.	7.3% to 10.9%	10.3% to 12.3%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	30%

CHICAGO

List price	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00
1/5 to std. pkg.	4.50

Standard packages, 500. List, each $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard packages, 500. List, each $0.07

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½-in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾-in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4⅝-in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg. ..... Net
Std. pkg. 10%

DISCOUNT—CHICAGO

Less than std. pkg. ..... Net
Std. pkg. 10%

LAMP CORD

Cotton Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00 to $34.90
Coil to 1000 ft.	26.20 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $30.00
Coil to 1000 ft.	21.50 to 22.30

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100 ..... $24.00

CHICAGO

Net per 100 ..... $21.75

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½ 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%	20%
$10.00 to $50.00 list	42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. 10%
1/5 to std. pkg. 20%
Std. pkg. 30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. 10%
1/5 to std. pkg. 20%
Std. pkg. 30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 26.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10 to $11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets.	500	$0.33
⅛-in. cap keyless socket.	500	.30
⅛-in. cap pull socket.	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... 15% to List
1/5 to std. pkg. ..... 15% to 20%

NET PER 100—CHICAGO

Less than 1/5 std. pkg. ..... 24% to 25.00
1/5 std. pkg. ..... 30% to 23.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100 amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low-Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+ 5%
$10 to $25 list	11%
$25 to $50 list	14%
	Low-Grade
Less than $10 list	5%
$10 to $25 list	16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Cont'd

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... List
1/5 to std. pkg. 15%
Std. pkg. 28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. ..... + 20% to list
1/5 to std. pkg. ..... List to 15%
Std. pkg. 30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 40%	Net to 30%
$2.00 to $10.00 list	10% to 50%	5% to 40%
$10.00 to $50.00 list	20% to 64%	15% to 52%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25%	20%

TOASTERS, UPRIGHT

NEW YORK

List price $6.00
Discount 30%

CHICAGO

List price ..... $4.50 to $6.00
Discount ..... 25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools.	$0.41¼-$0.44¼
No. 18, full spools.	0.36¼- 0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools.	$0.57½ to $0.65
No. 18, full spools.	0.50½ to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$12.50-$13.00	$9.85-$11.50
12	$23.25- 25.40	21.30- 21.80	15.95- 19.35
10	32.40- 35.20	29.70- 30.20	22.10- 27.00
8	45.70- 49.15	41.90- 42.10	30.85- 38.00
6	72.40- 77.85	66.35- 66.75	48.95- 60.30

CHICAGO

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00	$11.50
12	25.33-$26.25	22.02-$25.33	18.55-$20.93
10	30.49- 36.54	27.94- 31.26	22.86- 29.23
8	42.54- 51.57	38.99- 44.13	31.90- 41.36
6	61.38- 88.38	56.15- 75.61	50.53- 70.70

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $36.40
25 to 50 lb.	34.40
50 to 100 lb.	30.40 to 34.25

CHICAGO

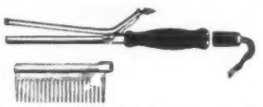
	Per 100 Lb. Net
Less than 25 lb.	$35.42 to $40.35
25 to 50 lb.	34.42 to 39.35
50 to 100 lb.	33.42 to 38.25

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Improved Electric Curling Iron

Landers, Frary & Clark, New Britain, Conn., have made an improvement on their type of combination curling iron and hair drier that was described in the ELECTRICAL WORLD for

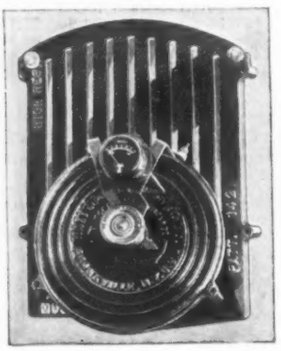


IMPROVED CURLING IRON FITS IN HANDBAG

Oct. 24, 1914. The handle receptacle is recessed, thus permitting the cord connector to enter the receptacle and make it more rigid. The curler rod of the latest type is an inch shorter than the old model, and the entire length of the appliance is reduced nearly 2 in. (5 cm.) and therefore allows the user to carry it more easily in a handbag. The heating unit consists of resistance wire flat-wound on a mica core and clamped between steel plates which have thermol contact with the curling tube through brass springs.

Regulator for Mazda Lamps

In order to use Mazda lamps for motion-picture projection the Argus Lamp & Appliance Company, 322 Euclid Avenue, Cleveland, Ohio, has developed the Sheck universal adapter for quickly adapting any carbon-arc motion-picture projecting machines and also a regulator for holding the voltage and current supply to the lamp at a constant value. If the voltage supplied to the lamp is too high, the life of the

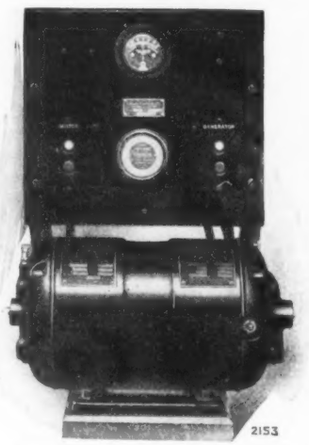


REGULATOR INSURES ACCURACY BUT REQUIRES LITTLE ATTENTION

lamp will be very short. To produce efficient results the current must be kept at the constant rated value of the lamp. A small reactance is used in the primary circuit to take care of all conditions of variations of line voltage. An ammeter is placed in the secondary so that the Mazda projector light can be held in the constant current, thus insuring a steady, brilliant picture. The accompanying illustration shows the two-piece regulating rheostat—the constant resistance to be mounted outside the booth and the small regulative resistance to be mounted in an accessible position for the operator.

Complete Battery-Charging Outfit

A complete 150-volt motor-generator set and switchboard for charging storage batteries is being manufactured by the Emerson Electric Manufacturing Company, 2024 Washington Boulevard,



BATTERY-CHARGING OUTFIT CONTROLLED FROM SWITCHBOARD BY PUSH-BUTTONS

St. Louis, Mo. The outfit is designed to charge two 6-volt batteries in series or one 12-volt battery. The switchboard is equipped with a rheostat for varying the charging rate, an ammeter for indicating the direction and amount of current flowing and a fuse block and cartridge fuses for protecting the motor. Push switches for starting the motor and for connecting the generator to the battery are also installed on the switchboard. The motor operates on a 110-volt, 60-cycle single-phase alternating-current energy supply.

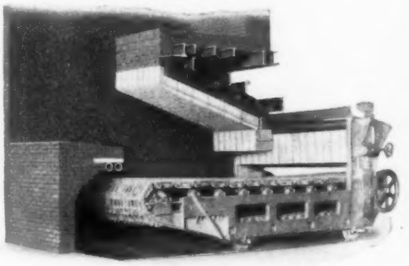
One-Line Clamshell Buckets

A combined clamshell bucket and carriage for use on overhead cables which requires only one hoisting rope, one single-drum engine or motor and one operator is being manufactured by the Blaw-Knox Company of Pittsburgh, Pa. The outfit is especially adapted for unloading and transferring materials from cars, barges or storage piles, and for removing coal from open cars.

A stop is attached to the supporting cable at the point where it is desired to lower the bucket. This stop may be shifted along the cable as required or it may remain fixed. When the bucket is being hoisted or lowered, the lower end of the carriage is automatically locked to this stop. When, however, the bucket is hoisted to the carriage, the pull of the carriage against the stop automatically locks the bucket to the carriage and at the same time releases the carriage from the stop and allows it to move upward along the supporting cable until it comes to a stop where it is again desired to lower the bucket. Upon reaching the upper stop a latch attached to the carriage engages the stop in such a manner that the slacking on the hoisting rope releases the bucket from the carriage. The bucket may be dumped at any point along the line or after being lowered at either end of the line. Renewed pull on the line raises the bucket to the carriage and locks it there. At the same time it raises the latch, permitting the carriage to move away from the stop.

High-Set Furnace Arch

The Green Engineering Company, East Chicago, Ind., has developed a type of boiler furnace arch called the "Sealflex," that is shown herewith. These arches are set higher and are pitched more steeply than ordinary arches and therefore allow more combustion space. The large angle of the arch reflects the heat from the rear portion of the fuel bed up to the grate and gives an intense and rapid ignition of the fuel. The manufacturer claims that from a practical standpoint it is impossible to maintain an air-tight joint between the gate and the end of



COLD AIR HEATED BY MEANS OF PROJECTING TILE

the arch under ordinary conditions because there is always a crack at this point through which cold air enters the furnace. Cold air also enters through the hopper between the gate and the coal. Usually this cold air retards

ignition when it comes in contact with the front portion of the arch. In this installation, however, the specially shaped tile projecting downward directly behind the stoker gate is grouted in place with the tile immediately behind it, thus forming a seal. All cold air entering the furnace at the stoker front must pass under this tile. It is heated so effectively by the tile before it can come in contact with the surface of the arch proper that the ignition is not affected. The arch proper is therefore not chilled and quickly reflects the rays of heat from the rear to the front of the stoker, where it is most needed for ignition. The single row of projecting tile and the front of the arch proper are set approximately 2 ft. (60 cm.) above the grate surface. The manufacturer claims that this arch gives increased ignition and more complete combustion, even with very low-grade fuel.

Combination Switch and Receptacle Plate

An outlet plate that is provided with a switch is being marketed by the Peerless Light Company, Halsted and Adams Streets, Chicago. The plate is made from heavy-gage brass finished to match any wood desired. It is advantageous for use in rooms that are without the necessary outlets because it saves the cost of extensive wiring.

Speed Reduction Gear That Requires Small Space

A mechanical drive for steam-plant auxiliaries and electric motor-driven units that allows driver and driven units to be lined up has been developed by the Poole Engineering & Machine Company of Woodberry, Baltimore, Md. The device requires small space for installation, and also saves considerable room in the power plant by allowing the two machines to be placed close together. The illustration shows the principle of operation, which consists of an internal gear attached directly to the slow-moving unit and a

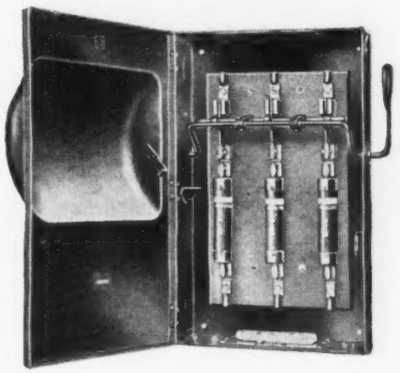
"SPEED TRANSFORMER" ELIMINATES CHAINS AND BELTS

small pinion in the center directly connected to the internal gear by three planet gear idlers. The planet gears are held in a stationary position, but are free to turn around on their own axes. When the internal gear rotates it moves the planet gears and thereby rotates the pinion. This action can be reversed —that is, the pinion can be driven to operate the planet gear and reduce the speed.

Steel-Inclosed Safety Switch

A safety switch with quick-break mechanism that is positive and insures simultaneous break at all blades is being manufactured by the Square D Company, Detroit. This line of steel-inclosed switches, which have been described in the ELECTRICAL WORLD at various times, are of simple construction and are completely inclosed in a sheet-steel box so designed that ample wiring space is provided inside to make the necessary connections. The box is provided with a hinged cover that is held closed by a spring, and the switch is operated by a crank handle on the outside. Raised letters on the box indicate the "on" and "off" positions of the switch.

The switch may be locked in the "off" position to prevent accidents while repairs are being made on apparatus controlled by it, provision being made for three individual padlocks. This padlock



SWITCH OPERATED FROM OUTSIDE BY MEANS OF CRANK

feature is advantageous when there is more than one man working on the line or equipment. When each man starts to work he locks the switch in the "off" position. This eliminates the possibility of either man throwing the switch "on" before all have finished working.

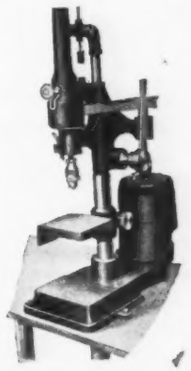
Aluminum Case Vacuum Cleaner

A nozzle which can be easily adjusted to clean thoroughly a carpet of any thickness is one of the features of a cleaner manufactured by the Innovation Electric Company, Inc., 585 Hudson Street, New York City.

The machine has an adjustable handle with rigid pistol grip made of polished hard wood. The handle automatically stands upright and can be arranged to hold the machine in any position for cleaning stairs. A push-button electric switch is attached to the handle in a convenient and accessible position. A tufted bristle brush is held in the nozzle by a rigid frame which can be swung into a convenient position for cleaning without removing any screws or belts. The device is equipped with a General Electric motor mounted horizontally.

Electric - Driven Sensitive Bench Drill Press

A bench drill press for boring all holes of size up to 3/16 in. (0.47 cm.) driven by a vertical 0.1-hp. Robbins & Myers motor is shown in the accompanying illustration. The drill is only



DRILL PRESS THAT OCCUPIES SMALL SPACE

24 in. (60 cm.) in height, and has a base that is 7.5 in. by 18 in. (19 cm. by 45.7 cm.). A quick adjustable table is provided which has a working surface of 5.5 in. by 5 in. (14 cm. by 12.7 cm.), and will take work up to 4.9 in. (11.1 cm.) in height. The standard spindle speeds are 2100 to 6000 r.p.m., but special pulleys can be furnished if desired to give a main spindle speed of 10,000 r.p.m. The drill press is manufactured by the High Speed Hammer Company, Inc., of Rochester, N. Y.

Socket-Attachment Bell Transformer

A bell transformer provided with a plug to fit the ordinary lamp base is being marketed by B. F. Miller, 201 South Clinton Avenue, Trenton, N. J. The "Liberty Bell" transformer permits easy installation and eliminates the necessity of the soldering of any

SECONDARY MAY BE SHORT-CIRCUITED WITHOUT HARM

connections, as it is provided with secondary binding-post terminals. The manufacturers claim that the transformer will not be harmed if secondary terminals are accidentally short-circuited.

Trade Notes

THE ANDERSON ELECTRIC SPECIALTY COMPANY of Chicago moved its offices from 564 West Van Buren Street to 118 South Clinton Street on May 1.

THE WARD LEONARD ELECTRIC COMPANY of Mount Vernon, N. Y., has placed a stock of its field rheostats, controllers and resistance units in San Francisco, Cal.

FRED D. WILLIAMS, connected with the H. W. Johns-Manville Company, Philadelphia, at head of the power specialties department, has resigned and will be associated with the L. H. Gilmer Company, Tacony, Pa., as assistant general manager.

J. M. RIORDAN, until recently sales engineer of the Grant Lees Gear Company of Cleveland, Ohio, and formerly representing the Fellows Gear Shaper Company of Springfield, Vt., in the Central States, is now connected with the sales organization of the Cleveland Milling Machine Company at Cleveland.

THE WALKER VEHICLE COMPANY of Chicago, on April 23 entertained the local electrical men who are interested in the electric vehicle business and who are members of the Chicago electric vehicle section of the National Electric Light Association. Following luncheon the members were conducted through the Walker factory.

THE SORGEL ELECTRIC COMPANY of Milwaukee, Wis., has just completed extensions and improvements, having taken two extra floors on its premises at 138 West Water Street. This space is used for enlarging the repair shop and for motor stock room. Additional machinery was installed and the facilities for handling heavy mechinery were improved.

THE GENERAL DEVICES AND FITTINGS COMPANY of Chicago, manufacturer of electrical products, has moved its executive and sales offices and engineering department from the factory, at 817-25 West Washington Boulevard, to the Mid-City Bank Building. It occupies the sixth floor of the building and by the move has secured greatly increased office facilities and drafting-room space.

THE BOSCH MAGNETO COMPANY of Springfield, Mass., and Plainfield, N. J., recently taken over for the government by A. Mitchell Palmer, custodian of alien property, was reorganized May 1. The new officers are: President, Joseph A. Bower of New York City; vice-president, Christian Girl, Cleveland; treasurer, George A. McDonald, Springfield, Mass.; secretary, William G. Fitzpatrick, Detroit; general manager, A. T. Murray, Allentown, Pa.; assistant treasurer, A. D. Altree, New York City. Domestic business will be carried on as formerly, it is announced.

THE WORTHINGTON PUMP & MACHINE CORPORATION, 115 Broadway, New York City, is now operating eight plants in the United States, as follows: The Worthington Works at Harrison, N. J., devoted exclusively to the manufacture of pumping machinery; the Blake & Knowles Works at East Cambridge, Mass., now entirely rebuilt and producing principally marine pumps; the Deane Works at Holyoke, Mass., which manufactures power pumps only; the Snow-Holly Works at Buffalo, N. Y., building the largest machines required in waterworks, blowing and gas-power engines and oil engines; the Power and Mining Machinery Works at Cudahy, Wis., which makes a complete line of crushing, concentrating and mining equipment; the Laidlaw Works at Cincinnati, Ohio, given over to air-compressing machinery only; the Jeanesville Works at Hazleton, Pa., working at present on a special product, and the International Gas Engine Works, at Cudahy, Wis., making a full line of gas and oil engines and accessories.

THE DEPARTMENT OF COMMERCE, Bureau of Foreign and Domestic Commerce, of Washington, D. C., according to a report published recently, says that American electrical goods have been in much greater demand in Australia since the war started than ever before. At present Australians do not have the same desire to adopt the semi-luxuries in electrical appliances that Americans of sufficient means will not do without. General conditions and methods of conducting business in Australia are described by the writer of the report, Commercial Agent R. A. Lundquist, who, however, devotes most of his space to detailed descriptions of the markets for particular lines of electrical goods, such as power-generating equipment, electric railway equipment, lamps and domestic appliances. The report is entitled "Electrical Goods in Australia," Special Agents Series No. 155, and is sold for 15 cents by the superintendent of documents, Government Printing Office, Washington, D. C., and by all the district and co-operative offices of the Bureau of Foreign and Domestic Commerce.

Trade Publications

BALL BEARINGS.—Blotters advertising ball bearings have been issued by the Fafnir Bearing Company of New Britain, Conn.

ELEVATORS.—The Warner Elevator Manufacturing Company is distributing bulletins Nos. 3200, 3100 and 2850, describing its elevators.

BUCKETS.—Single-line clamshell buckets are described in an illustrated booklet recently issued by the Blaw-Knox Company of Pittsburgh, Pa.

FITTINGS.—"Conduit Fittings and Electrical Specialties" is the title of catalog No. 26 issued by Thomas & Betts Company, 63 Vesey Street, New York City.

LIGHTING FIXTURES.—The Davlite Fixture Company, 416 South Dearborn Street, Chicago, has issued a bulletin describing the Bel-Ko-Lite lighting fixture.

GUY WIRE ANCHORS.—The Matthews "Scrulix" guy-wire anchors are described in a circular post card being distributed by W. N. Matthews & Brother, Inc., of St. Louis, Mo.

RHEOSTATS.—The Ward-Leonard Electric Company, Mount Vernon, N. Y., has issued bulletin No. 50, entitled "Method of Determining the Size of Battery Charging Rheostat."

TRUCKS.—"Truck Talk" No. 22 is being distributed by the General Motors Truck Company of Pontiac, Mich. This number illustrates some installations and uses of the trucks.

FARM LIGHTING SYSTEMS.—The Domestic Engineering Company, Dayton, Ohio, has issued a circular reproducing advertisements to be published soon in the various popular mazagines.

GAS-FILLED LAMPS.—The Whitelite Electric Company, 368 Broome Street, New York City, is distributing several booklets and blotters describing its gas-filled lamps for industrial and domestic uses.

FARM LIGHTING SYSTEMS.—The Electromatic System Company, 2136 Michigan Avenue, Chicago, is distributing circulars describing its farm lighting systems, which do not require a storage battery.

BRACKETS.—Bulletin No. 602 is being distributed by the National Metal Molding Company, Pittsburgh, Pa., showing its "National" brackets, which are complete with insulators and do not necessitate the use of tie wires.

LIGHTING FIXTURES.—The Beardslee Chandelier Manufacturing Company, 216 South Jefferson Street, Chicago, has issued a folder describing and illustrating the Denzar lighting fixture for both ceiling and pendent-type installations.

ELECTRIC BARBER SUPPLIES.—The Racine Universal Motor Company, 53 West Jackson Boulevard, Chicago, has issued a folder showing its Moore electric hair cutter and vibrator and hair-drying attachment for the hair-cutter machine.

LIGHTING AND AUTOMOBILE SPECIALTIES.—The Anderson Electric Specialty Company, 118 South Clinton Street, Chicago, has issued a booklet describing and illustrating a line of small lighting specialties and electric automobile supplies.

MOTION-PICTURE TRANSFORMERS.—The Lea-Bel Company, 610 Schiller Building, Chicago, is distributing a circular describing the Lea-Bel transformer and current regulator to be used with Mazda gas-filled lamps for motion-picture projection.

ELECTRICAL APPARATUS.—The General Electric Company of Schenectady, N. Y., has issued a bulletin describing its pressure governor for alternating-current or direct-current circuits, No. CR 2922, and its bulletin No. 57,419, illustrating parts of type FP-10 oil circuit breakers.

DRINKING - WATER SYSTEM.—The Armstrong Cork & Insulation Company, Pittsburgh, Pa., has issued a circular entitled "Satisfaction or——," which discusses the subject of industrial drinking-water systems. Copies of the folder will be supplied by this company upon request.

WIRE.—The Driver-Harris Company, Harrison, N. J., has recently issued a circular describing its wire baskets for dipping purposes. These baskets are made of nichrome wire. The company is also distributing a folder describing pure sheet nickel for manufacturing purposes.

New Incorporations

THE ALABAMA PUBLIC SERVICE COMPANY of Jasper, Ala., has been incorporated with a capital stock of $3,000 by F. L. Fuller, E. T. Rice and N. H. Prickett.

THE NIXON (TEX.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by J. F. Wood, Jr., W. L. Hoover and C. T. Morene. The company is capitalized at $3,000.

THE SOUTHERN CITIES POWER COMPANY of Chattanooga, Tenn., has been incorporated by George B. Adams, J. C. Stickney, G. W. Erwin, J. H. Ramyer and John R. Evans. The company is capitalized at $50,000.

THE TWIN DRY CELL BATTERY COMPANY of Cleveland, Ohio, has been incorporated by H. R. Palmer, A. G. Brainard, Robb O. Bartholomew, Ralph L. Bailey and John P. Nally. The company is capitalized at $25,000.

THE WINNEBAGO ELECTRIC COMPANY of Winneconne, Wis., has been incorporated with a capital stock of $5,000 to supply electricity for lamps and motors in Winnebago. The incorporators are: Richard W. Button and A. Q. Button.

THE BRITISH-AMERICAN PRODUCTS, Inc., has filed articles of incorporation with a capital stock of $500,000 to do a general electrical, mechanical and constructing engineering business. The incorporators are: A. W. Britton, S. B. Howard and Paul S. Smith of New York, N. Y.

THE C. E. STAPP ELECTRIC COMPANY of Peoria, Ill., has been chartered with a capital stock of $20,000 for the purpose of doing a general electrical contracting business and dealing in electrical supplies. The incorporators are: C. E. Stapp, C. F. Theobald and E. T. Cunningham.

THE SOUTH NEW CASTLE ELECTRIC COMPANY of New Castle, Pa., has been granted a charter with a capital stock of $5,000 to supply electricity for lamps and motors in this borough. The directors are: J. C. Chesnut and L. B. Round of New Castle and A. E. Dedricks of Youngstown, Ohio.

THE CONLAN ELECTRIC CORPORATION of New York, N. Y., has been incorporated by David Conlan, Jr., Robert S. Conlan of the Bronx and Frank A. Butler of Ridgewood, N. J. The company is capitalized at $10,000 and proposes to do a general electric contracting and manufacturing business.

THE DEXTER & ADAMS MACHINE COMPANY of New York, N. Y., has been incorporated by R. H. Garretson, G. Rosendale and S. C. Whitbeck, 52 Broadway, New York City. The company is capitalized at $50,000 and proposes to manufacture machinery and appliances and to do a general electrical and mechanical engineering business.

COMPANIA DE SERVICIO PUBLICO DE SANTA MARTA has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to construct and operate telephone, telegraph and electric light, heat and power systems. The incorporators are: Ferris Giles, E. M. Haslam and E. Lemon of Wilmington, Del.

THE INTERNATIONAL WESTERN ELECTRIC COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $20,000,000. The company proposes to manufacture all kinds of electrical instruments and machinery and to engage entirely in foreign trade. The incorporators are: William O'Keefe, E. E. Aberle and J. H. Dowdell of Wilmington, Del.

THE CENTRAL ELECTRIC DEVELOPMENT & HOLDING COMPANY of Humboldt, Iowa, has been organized for the purpose of building farmers' co-operative electric light and power systems, the cost of the individual systems to vary from $600 to $1,000. The officers of the company are: I. C. Elston, Jr., of Chicago, Ill., president; W. J. Brownell of Sioux City, vice-president; D. M. Sterns, secretary and general manager, and L. Winne, treasurer.

THE EMPIRE POWER CORPORATION of Niagara Falls, N. Y., has been granted a charter by the Secretary of State. The company is capitalized at $3,000,000 and proroses to build a power plant at the head of the falls. The power house, intake tunnel and all buildings are to be built underground. The incorprators are: Frank B. Baird, 1069 Delaware Avenue; Edward L. Koons, 1131 Delaware Avenue, and Myron S. Hall, 184 Bidwell Parkway, Buffalo, N. Y.

New England States

EASTPORT, ME.—The Eastport Electric Company, recently organized with a capital stock of $25,000, is installing a new plant in Eastport. S. D. Leavitt is president.

MANCHESTER, N. H.—A permit has been granted the Manchester Traction, Light & Power Company to erect a boiler house near Mast Street.

BELLOWS FALLS, VT.—The substation of the Rockingham plant of the Fall Mountain Electric Company was recently damaged by fire. Switchboards, transformers and high-tension wires were destroyed, causing a loss of about $10,000.

ENOSBURG, VT.—The Butterfield Electric Company, recently incorporated with a capital stock of $150,000, proposes to develop hydroelectric power on the Missisquoi River in the towns of Montgomery, Berkshire and Enosburg. The incorporators are: C. E. Nelson, B. F. Butterfield of Derby Line; Ralph Buck and C. T. Hall of Montgomery.

SPRINGFIELD, VT. — The Colonial Power & Light Company has secured a contract for supplying secondary power to the amount of 100 kw. to the woolen mill at Proctorsville. Plans are now being prepared for the erection of a new 11,000-volt transmission line to the mill.

BOSTON, MASS.—Bids will be received by the Commission on Waterways and Public Lands, Room 473, State House, Boston, Mass., until May 27 for the erection of a brick building, about 109 ft. by 41 ft., for pump house at the dry dock at South Boston, including rooms for offices and transformers, on concrete foundations. Frank W. Hogdon is engineer.

BROCKTON, MASS.—Andrew L. Hunter, president of the Common Council, has asked that an investigation be made at once of the electric plant in the city hall to see if it cannot be repaired and utilized to supply electricity to light that building.

CAMBRIDGE, MASS.—Work has begun on the construction of an engine building, 43 ft. by 190 ft., one story, at the Massachusetts Institute of Technology at Cambridge.

BRIDGEPORT, CONN. — Contract has been awarded by the United Illuminating Company to the New England Iron Works, 94 Commerce Street, New Haven, for alterations and improvements to its local power house.

DANIELSON, CONN.—Preparations, it is reported, are being made for the erection of a power house at the Goodyear Cotton Mills. The cost of the proposed plant is estimated at $150,000 and the equipment will include steam turbine engines. The company is controlled by the Goodyear Tire & Rubber Company of Akron, Ohio.

NEW HAVEN, CONN.—Bids will be received at the office of the supervising architect, Treasury Departmeit, Washington, D. C., until May 21 for furnishing and installing interior lighting fixtures in the United States post office at New Haven. Copies of plans and specifications may be obtained at the above office.

NEW HAVEN, CONN.—Upward of 2000 acres of land have been secured by the Connecticut Light & Power Company in the towns of New Fairfield and Sherman for a site for its proposed new storage reservoir, to be used as an auxiliary to the dam now under construction at Zoar Bridge. No power house is contemplated in connection with the second dam.

NORWICH, CONN.—The City Gas and Electric Department has awarded the contract for construction of the foundations for the two new boilers, turbine, two 12,000-gal. oil drums and small brick building for blowers to C. M. Williams.

WESTPORT, CONN.—A. S. Green of Westport has been awarded the contract to install a number of Western Electric searchlights at the government works at Fields Point, R. I.

Middle Atlantic States

BROOKLYN, N. Y.—The Clark Electric & Manufacturing Company, 149 Broadway, New York, has purchased a factory building at 22 Vanderbilt Avenue, near Flushing Avenue. The company manufactures electrical goods.

BROOKLYN, N. Y.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13, extension of date from May 6, under specification 2913 for installing an electrically-operated traveling crane in the structural shop at New York, to cost about $8,500.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Municipal Building, New York, until May 13 for electrical work at the Boys' Vocational School, Cary Building, Jay and Nassau Streets. Also for alterations, repairs, electric work, heating, etc., at Public School 158, Belmont Avenue, Ashford and Warwick Streets, borough of Brooklyn. A separate bid to be submitted on each item.

BUFFALO, N. Y.—Contracts will soon be awarded by the War Department, Cantonment Division, Washington, D. C., for the construction of buildings for an aero testing field at Buffalo, to cost about $425,000.

BUFFALO, N. Y.—Contract has been awarded by the Kellogg Products Company, 98 Delaware Avenue, for the construction of a new pumping plant at 1317 Elk Street to B. I. Crooker, Builders' Exchange, Buffalo.

BUFFALO, N. Y.—Contract has been awarded by the Delaware, Lackawanna & Western Railroad Company for the construction of a power house at East Buffalo to John W. Cowper, Fidelity Building, Buffalo.

CHATEAUGAY, N. Y.—The Chasm Power Company has petitioned the Public Service Commission for permission to issue $25,000 in bonds, the proceeds to be used to pay the expense of building an auxiliary power house and equipping same to be used in case of emergencies, the cost of which is estimated at $23,500.

NEWFANE, N. Y.—Owing to an increase in rates from $14 to $21 each per year for street lamps the residents of the village of Newfane have voted to discontinue the street-lighting service. The contract with the Lockport Felt Company, which controls the electric plant in Newfane, will expire soon.

NEW YORK, N. Y.—The capital stock of the Novo Manufacturing Company, 4234 West Thirty-third Street, manufacturer of electrical goods, has been increased from $100,000 to $150,000.

NEW YORK, N. Y.—The capital stock of the E. J. Electric Installation Company, 221 West Thirty-third Street, has been increased from $10,000 to $50,000, the proceeds to be used for expansion purposes.

NEW YORK, N. Y.—Plans have been filed by the B. E. Davis Company, 250 Hudson Street, for the construction of a new eight-story battery building, to be located on Hudson Street, between Broome and Dominick Streets. Contract has been awarded to the Pershing Construction Company, 309 Broadway, New York City.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Municipal Building, New York, until May 13 for electric work at Public School 43, 129th Street and Amsterdam Avenue. Also for bids for installing electric equipment in addition to and alterations in Public School 32 on East 183d Street, between Cambreling and Beaumont Avenues. Separate bids to be submitted on each item.

NIAGARA FALLS, N. Y.—Plans have been filed by the Star Electrode Works of the National Carbon Company for the construction of a new mixing and milling building. Braas Brothers, 110 Whitney Avenue, Niagara Falls, are contractors.

OGDENSBURG, N. Y.—Plans are being prepared by the New Jersey Zinc Company, 55 Wall Street, New York City, for rebuilding its local power house, recently destroyed by fire. The cost of the proposed plant is estimated at $15,000.

POTSDAM, N. Y.—Work has been resumed by the St. Lawrence Transmission Company on the construction of its dam across the Racquette River at Colton, and at Brons Bridge, where it is erecting a power house for the development of the water power. Machinery, is is understood, has been purchased.

SYRACUSE, N. Y.—The Public Service Commission has granted the Syracuse Lighting Company permission to extend its electric transmission lines to Geddes to furnish electricity for lamps and motors in that town.

WEST HAVERSTRAW, N. Y.—Bids will be received by George Blagdon, president of the board of managers of the New York State Hospital for Care of Crippled and Deformed Children, West Haverstraw, until May 22, for laundry equipment for the New York State Hospital for Crippled and Deformed Children. Drawings and specifications may be consulted at the above hospital, at the New York office of the Department of Architecture, Room 1224, Woolworth Building, New York City, and at the Department of Architecture, Capitol, Albany, N. Y.

BLOOMFIELD, N. J.—Contract has been awarded by the Sprague Electric Company, Watsessing Street, for the erection of an addition to its plant to the Austin Company, Transportation Building, Philadelphia, Pa. The structure will be about 100 ft. by 180 ft., and the cost is estimated at $35,000.

HOBOKEN, N. J.—The Lux Manufacturing Company, Fifteenth Street, has purchased a four-story factory on East Kinney Street, with about 50,000 sq. ft. floor space. The company manufactures large nitrogen and tungsten lamps. A. P. Baldwin is president and treasurer.

KEARNY, N. J. — Contract has been awarded by Swift & Company of Jersey City to the Ruggles-Robinson Company, 331 Madison Avenue, New York City, for the erection of a power house in connection with the construction of a new glue factory in Kearny. The cost of the entire plant is estimated at $65,000. The company is also planning to build an addition to its engine house at 154 Ninth Street, Jersey City, for which plans have been prepared.

ORANGE, N. J.—A permit has been taken out by the Radium Luminous Materials Corporation for the erection of a new four-story building at 166 Alden Street.

TRENTON, N. J.—Preliminary plans are being prepared by J. Osborne Hunt, 114 Montgomery Street, Trenton, for the construction of a new power house at the plant of the John E. Thropp Sons Company, Lewis Street.

TRENTON, N. J. — Major Edmund J. Barry, who is in charge of the government munitions plant at Tullytown, Pa., has issued orders that additional power be supplied to the Trenton, Bristol & Philadelphia Street Railway from the power house of the Trenton & Mercer County Traction Company at Trenton. Transmission lines will be erected through the streets of Trenton across the Delaware River to connect with the line of the former company at Morrisville, Pa.

ERIE, PA.—The City Council has awarded the contract for lighting the streets of the city to the Erie County Lighting Company for a period of five years.

HARRISBURG, PA.—Bids will be received by the Board of Commissioners of Public Grounds and Buildings until May 14 for furnishing power plant specialties for the year ending May 31, 1919. George A. Shreiner is superintendent.

MIDDLEBURG, PA.—The Juniata Electric Company of Mifflin has taken over the plant of the Middleburg Electric Light, Heat & Power Company.

PHILADELPHIA, PA.—Bids will be received by the Department of Public Safety for improvements and alterations in the municipal power plant. William H. Wilson is director of public safety.

PHILADELPHIA, PA.—Permit has been taken out by the Royal Ascot Knitting Company, 92 Collum Street, for the construction of an addition to its boiler plant at 240 East Ashmead Street.

PHILADELPHIA, PA.—Plans have been prepared by the Electric Storage Battery Company for improvements to its building, including a new addition, at Nineteenth Street and Allegheny Avenue.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 20 under specification 2947 for furnishing an electric-lighting system for shipbuilding slip at Philadelphia. Fur further information address chief of bureau.

CUMBERLAND, MD.—Preliminary work, it is reported, has begun on the construction of the proposed plant for the Kelly-Springfield Tire Company of Akron, Ohio, in Cumberland. The present plans, it is understood, include the erection of a power station. The cost of the plant is estimated at $1,000,000.

CHARLESTON, W. VA. — The Virginia Power Company is contemplating erecting additional transmission lines to Nitro, a distance of 16 miles, to furnish electricity to the federal government explosive plant. H. G. Scotto of Charleston is general manager.

HARPERS FERRY, W. VA.—The Public Service Commission has approved of an issue of $500,000 in bonds by the Northern Virginia Power Company, the proceeds to be used for the development of hydroelectric projects in the eastern panhandle of West Virginia.

BRISTOL, VA.—The Norfolk & Western Railroad Company is planning to erect new shops and buildings at its Bristol yards to cost about $500,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13 for furnishing and installing cables, wires, transformers, and accessories for the electric and telephone systems for drydock No. 4 at the navy yard at Norfolk. Drawings and specifications No. 2875 may be obtained at the above bureau or to the commandant of the navy yard named.

RICHMOND, VA.—The Virginia Railway & Power Company has awarded a contract to Nicholas & Linderman of Norfolk for alterations and improvements to its substation, to cost about $11,700.

SEVEN PINES, VA.—Contract has been awarded by the War Department, Washington, D. C., to the Foundation Company, Woolworth Building, New York, N. Y., for the construction of a powder packing plant at Seven Pines, to cost about $3,000,000. The project will include an electric power plant, heating equipment, large warehouse and 40 miles of railway trackage. E. I. du Pont de Nemours & Company of Wilmington, Del., will operate the plant for the Government.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company has awarded contract for the erection of a new telephone exchange building to the Samuel K. Prescott Company, 814 Thirteenth Street, N. W. The cost is estimated at about $800,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13, extension of date from May 6, under specification 2879 for installing substation switchboards at the navy yard, Washington The cost is estimated at $60,000.

WASHINGTON, D. C.—Bids will be received by the Commissioner of Indian Affairs, Indian Office, Department of the Interior, Washington, D. C., until May 20 for the installation of an electric-lighting plant at the Southern Ute School, Colorado. Plans and specifications may be examined at the United States Indian warehouse at Chicago, Ill., St. Louis, Mo., San Francisco, Cal., and the Builders' Exchange, St. Paul, Minn., and at the office of the superintendent of the Southern Ute School, Colorado. Cato Sell is commissioner.

North Central States

BELLAIRE, MICH.—A special election will be held on May 13 to submit to the voters the proposal to issue $6,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant. It is proposed to establish a day service.

SPRINGWELLS, MICH.—Contract, it is reported, has been awarded by the Saxon Motor Company for the erection of a power plant in Springwells to Bryant & Detwiler.

COLUMBUS, OHIO.—An addition is being erected to the power plant of the Columbus Anvil & Forging Company. New equipment to increase the output of the plant nearly 50 per cent, it is understood, will be installed.

HAMILTON, OHIO.—Preparations are being made by the Shuler & Beninghofen Company of Hamilton for an extension to its power plant. Most of the equipment, it is understood, has been purchased.

LIMA, OHIO.—Steps have been taken by the Lima Advertising Club for the installation of an ornamental lighting system in the business district.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company is installing transformers to be used in connection with the high-tension line connecting its station with the high-tension service of the Lake Shore Electric Railway Company.

SANDUSKY, OHIO. — Property owners just outside of the city limits, near the bay shore, have petitioned the Sandusky Gas & Electric Company for electrical service. The district to be served is just beyond the present service lines of the company.

WAPAKONETA, OHIO.—Plans are being prepared by Kruckemeyer & Strong, architects, Cincinnati, for the construction of a new telephone exchange building for the Wapakoneta Telephone Company. The system to be installed has not yet been decided upon.

EARLINGTON, KY.—The St. Bernard Mining Company is planning to construct a large power plant in Earlington to supply power for its mines in this territory. Contract for electrical work, it is reported, has been awarded to the Westinghouse Electric & Manufacturing Company of Pittsburgh. The cost of the plant is estimated at $500,000.

FRANKLIN, IND.—The construction of a new science hall, 125 ft. by 95 ft., to cost about $125,000, is under consideration by the trustees of Franklin College. C. F. Goodell is president.

SOUTH BEND, IND. — The installation of electrical equipment in the forge department and machine shops, to cost about $27,000, is contemplated by the Studebaker Corporation.

CALUMET, ILL.—Bids will be received by John McGillen, clerk of the Sanitary District of Chicago, 980 South Michigan Avenue, Chicago, until June 6, for construction of the Calumet sewage pumping station as follows: Division A—consisting of a concrete and brick building, 80 ft. by 185 ft., with suction discharge basins, 15-ton hand crane, sluice gates and accessories, etc. Division B—pumping machinery, consisting of three 72-in. centrifugal pumps, with suction and discharge and vacuum piping, priming pumps and accessories; one 72-in. centrifugal pump in addition may be ordered at the option of the Sanitary District. Division C—electrical equipment, including six 1000-kva. transformers, three 1100-hp. synchronous motors, two 450-hp. synchronous motors, three 300-hp. synchronous motors, six 50-kva. transformers, two 75-kw. motor-generator sets, and oil switch equipment. Division C—switchboard, conduit and wiring, including control switchboard and accessories, conduit and wiring for connecting all electrical equipment and for station lighting and power, installation of electrical equipment. Specifications, forms of proposal and plans may be obtained at the above office.

CICERO, ILL.—Bids, it is reported, are being asked by the Western Electric Company of Chicago for the construction of a new factory, six stories, at Cicero, to cost about $800,000.

JANESVILLE, WIS. — The Supervisors of Rock County are considering the installation of an improved lighting system at the County Asylum and Almshouse. Supervisor Perrigo is chairman of the special committee.

MILWAUKEE, WIS.—The Pfau Motor Pump Company, 248 Fourth Street, recently incorporated with a capital stock of $50,000, is contemplating the construction of a new plant. The company manufactures electrically driven compressed-air water-pumping systems.

OSHKOSH, WIS.—The Oshkosh Gas Light Company is building a new power plant on the north bank of Fox River. The building will be about 100 feet square and 90 feet high. Three new boilers equipped with automatic stokers are being installed in the boiler room.

HASTINGS, MINN. — Bids will be received by the Minnesota State Board of Control, State Capitol Building, St. Paul, until May 14, for construction of the west wing to main building of the State Asylum at Hastings, including general contract work, heating and ventilating, electrical work and plumbing. Plans and specifications are on file at the office of the Board of Control, Builders' Exchange, at St. Paul and Minneapolis, and at the office of C. H. Johnston, architect, Capital Bank Building, St. Paul.

PRINCETON, MINN.—Bids will be received by the board of education, Princeton, until May 20, for the construction of a high school building. Separate bids to be submitted on mechanical equipment. Plans and specifications are on file in the office of A. B. Gramer city clerk. Foss & Foss of Elbow Lake, Minn., are architects.

CLINTON, IOWA. — The Climax Engineering Company, it is reported, has purchased the property of the Klein Paper Mill on the Beaver Slough at the foot of Fifth Street, on which it will erect a new plant, including a power house, which will be equipped with a 500-hp. engine and generators. Orders have been placed for machinery.

LADORA, IOWA.—A company is being organized under the name of the Farmers' Electric Light Association to install and operate an electric-lighting system in Ladora.

MANCHESTER, IOWA.—The Delaware County Light & Power Company, recently incorporated, has purchased the Quaker Mill property about two miles up the river from Manchester, which it proposes to develop to generate electricity and transmit it to Manchester. The company will also continue the mill and feed grinding business. The company is capitalized at $25,000. Joseph Hutchinson is president, and Harry Seeds, secretary and treasurer.

MONTICELLO, IOWA.—The Monticello Electric Company is contemplating extending its electric transmission lines out of the city to supply electrical service to the farmers west of the town as far as Linn County.

WASHINGTON, IOWA.—Bids will be received by the board of education, care of R. W. Thompson, secretary, until May 17 for construction of a high school building, including heating, plumbing and electric wiring. The cost is estimated from $140,000 to $150,000. C. A. Dieman & Company, Granby Building, Cedar Rapids, are architects.

YORKTOWN, IOWA.—The Lee Electric Light & Power Company has submitted a proposal to the Town Council offering to erect an electric transmission line to Yorktown from its line running from Shenandoah to Clarinda to supply electricity here for $5,000.

KANSAS CITY, MO.—Bids will soon be awarded by the Kansas City Railways Company for the erection of a substation at 1017 Oak Street, to cost about $25,000. C. E. Fritts, Fifteenth and Grand Avenues, is electrical engineer.

KANSAS CITY, MO.—J. F. Porter, president of the Kansas City Light & Power Company, has announced that work on the construction of its large plant at Brooklyn Avenue and the river front will be resumed. Work on the foundation was held up after the general strike.

KIRKSVILLE, MO.—Extensive improvements are contemplated by the Adair County Light, Power & Ice Company to its plant and system.

LITTLE BLUE, MO.—The Green Light & Power Company, which supplies electrical service in Lees Summit, is contemplating extending its lines to Little Blue.

PLATTSBURG, MO.—The Clinton County Telephone Company has authorized an issue of $6,500 in bonds for improvements to its system.

COURTENAY, N. D.—A second generating unit, consisting of a General Electric 37½-kva., 60-cycle, 2300-volt alternator and a 35-hp. Muncie oil engine, is being installed in the municipal electric-light plant. As soon as improvements are completed a day service will be established. G. D. Roth is manager.

MADDOCK, N. D.—Preparations are being made for the installation of an electric-lighting system in the city of Maddock, for which bids have already been received.

GURLEY, NEB.—Preparations are being made for the installation of a municipal electric-light plant, for which bids have already been received. Royal D. Salisbury, 1415 East Colfax Avenue, Denver, Col., is consulting engineer.

LYNCH, NEB.—Bonds to the amount of $7,800 have been voted for the installation of an electric-light plant in Lynch.

NORFOLK, NEB.—Plans are being prepared for the construction of a power house at the State Insane Hospital at Norfolk, to cost about $40,000. Bids for construction, it is understood, will soon be asked by the Board of Commissioners of State Institutions. Plans are also being prepared for the construction of ward building for the above hospital, to cost about $70,000. J. C. Stitt is architect for both buildings. Leo Matthews of Lincoln is secretary of board.

BROOKVILLE, KAN.—Bonds have been voted to provide funds for the erection of an electric distribution system in Brookville. Energy to operate the system will be purchased from the Central Kansas Power Company of Manhattan.

CONCORDIA, KAN.—The pumping station of the Concordia Electric Light Company was recently destroyed by fire.

EDGERTON, KAN.—At an election to be held May 14 the proposal to issue $5,000 in bonds for the erection of an electric distribution system in Edgerton will be submitted to the voters.

GARDNER, KAN.—At an election to be held May 14 the proposal to issue $10,000 in bonds for the installation of an electric light plant will be submitted to the voters.

GARNETT, KAN.—The City Council has called an election to be held June 4 to submit the proposal to issue $65,000 in bonds for improvements to the municipal electric-light plant and water-works system to the voters. Black & Veatch, 507 Inter-State Building, Kansas City, Mo., are engineers.

WICHITA, KAN.—Plans are being prepared for a power house and laundry for the St. Francis Hospital, to cost about $20,000. E. Forsblom, Winne Building, is architect.

WICHITA, KAN.—The contract for electric wiring of the new addition to the Forum Building has been awarded to the Southwestern Electric Company. The cost of the entire work is estimated at $130,000.

WINFIELD, KAN.—Work will start at once on the construction of a building for the St. Mary's Hospital. The plans provide for the installation of electric passenger elevator, dumb waiter, refrigerating system, electric wiring, etc. The cost is estimated at $80,000. H. L. Stevens & Company, 900 South Michigan Avenue, Chicago, Ill., are architects and contractors.

Southern States

CHARLOTTE, N. C.—The city of Charlotte would like to receive proposals from manufacturers of pumping equipment upon certain centrifugal pumping units. Further information may be obtained at the office of the commissioner of public works or Anderson & Christie, consulting municipal engineers of Charlotte.

BRANCHVILLE, S. C.—Prescott Ott, it is reported, is in the market for equipment for an electric-light plant.

REIDSVILLE, GA.—Bonds to the amount of $10,000 have been voted for the installation of a municipal electric-light plant.

SARASOTA, FLA.—A movement has been started by the Board of Trade for the purchase of the property of the Sarasota Ice & Electric Company, which now furnishes electrical service in the city. The company has a 30-year franchise with provision that the city may purchase the plant at the end of any 10-year period. The board proposes the purchase of the plant by the city and the installation of the necessary machinery to furnish a 24-hour service. The City Council has engaged a consulting engineer to make investigations.

LYLES, TENN.—The Bon Air Coal & Iron Corporation of Nashville, it is reported, will construct and operate a wood chemical plant for the United States government. The cost of the plant is estimated at $1,300,000 and will include power house, stillhouse, 20 retorts, etc. The George A. Fuller Construction Company, Fuller Building, New York, N. Y., has the contract.

GADSDEN, ALA.—Work has begun by the Alabama Power Company on the installation of the division switchboard and meters to be used in delivering energy to operate the local water-works system. It is proposed to change the plant from steam to electric power. Orders have been placed for motors and pumps.

CLARKSDALE, MISS.—Bids will be received by the school board, addressed to R. E. Stratton, city clerk, Clarksdale, until May 22 for construction of school building including heating, plumbing, electric-lighting, etc. Bonds to the amount of $95,000 have been issued for building and equipment. Plans and specifications may be obtained from R. H. Hunt of Chattanooga, architect.

GUEYDAN, LA.—The city is contemplating the installation of a municipal electric-light plant for which $15,000 in bonds have been voted.

NEW ORLEANS, LA.—The Liberty Manufacturing Company, recently incorporated, has acquired a plant at Carrollton Avenue and Oleander Street, and will engage in the manufacture of electrical and foundry machinery and other products. Eph. Rosenburg is president and B. B. Hans, secretary and treasurer.

JENNINGS, OKLA.—The City Council is considering calling an election to submit the proposal to issue $25,000 in bonds for an electric lighting system, $20,000 for water-works, $20,000 for sewers, and $18,000 for an ice plant to the voters.

MIAMI, OKLA.—Bids will be received until May 18 for the construction of a hospital at the Baptist Sanitarium at Miami. Separate bids to be submitted on vacuum steam heating, plumbing, electric wiring and electric elevator. A. J. Bellis, 615 Grear-Leslie Building, Kansas City, Mo., is architect.

OILTON, OKLA. — The Council has granted the Central Oklahoma Lighting & Power Company a franchise to furnish electricity in Oilton for commercial purposes.

SHATTUCK, OKLA.—Improvements to cost about $20,000 are contemplated to the municipal electric light plant, and also to the waterworks, to cost about $50,000. Burns & McDonnell, 402 Inter-State Building, Kansas City, Mo., are engineers.

TULSA, OKLA.—The Commerce Building Corporation, First National Bank Building, Tulsa, has awarded contract for construction of a bank and office building at 324 Main Street to the George A. Fuller Construction Company, Dwight Building, Kansas City, Mo. The plans provide for the installation of a private lighting plant. The cost is estimated at $500,000. Rush, Endacott & Rush, 226 Unity Building, are architects.

AUSTIN, TEX. — Contract has been awarded by the War Department, Washington, D. C., for the construction of cantonment buildings at Camp Mabry, near Austin, for aviation field to J. F. Johnson of Austin, to cost about $400,000.

KNIPPA, TEX.—Preliminary surveys have been made for the construction of a large hydroelectric power plant on the Frio River, near here, and a large irrigation system. The site of the proposed dam is located about 14 miles north of Knippa, and will have a capacity of about 5000 acre ft., which will irrigate about 100,000 acres of valley land. Electricity generated at the proposed dam will be transmitted to San Antonio and a number of smaller towns. Charles A. Lindsey of Wichita, Kan., and associates have applied to the State Board of Water Engineers for authority to divert and utilize the water of the stream.

TOM BEAN, TEX.—A company has recently been organized for the purpose of installing and operating an electric-lighting plant in Tom Bean.

Pacific and Mountain States

CHEHALIS, WASH.—At an election held April 20 the proposal to grant C. E. Anderson and associates of Portland, Ore., a franchise to operate a second electric-lighting and power system in Chehalis was defeated. The North Coast Power & Light Company, which furnishes electrical service here, has recently (voluntarily) granted a reduction in its rates of approximately one-third.

EVERETT, WASH.—The City Council has engaged Burns & McDonnell of Kansas City, Mo., to make investigations and prepare estimates of the cost of establishing a power plant in the upper Sultana River district.

OLYMPIA, WASH. — Application has been filed with the state engineer by P. C. Kaylor for 9000 second ft. of water from the Spokane River, to be used for hydroelectric development.

SEATTLE, WASH.—Equipment is being installed by the Coast Engine Company of Seattle for the manufacture of small electric lighting plant to be operated by heavy oil engines of 2½ hp.

SPOKANE, WASH. — Application has been filed by the Washington Water Power Company of Spokane for permission to construct a reservoir and store unappropriated waters of the Baker River, to the amount of 30,000 acre ft., to be used for power development. The cost of the proposed project is estimated at about $1,000,000.

ASTORIA, ORE.—The contract for the installation of electric wiring and equipment for the new bulk grain storage bins and workhouse has been awarded to the Ewart Electric Company of Astoria, at $9,588.

GRANTS PASS, ORE.—The Crown-Willamette Paper Company of Grants Pass has been granted permission by State Engineer Lewis to appropriate 200 second ft. of water from Young River, near Astoria, for the development of 2273 hp. The cost of the proposed plant is estimated at $150,000 and will include the construction of an 80-ft. dam, short pine line and power house.

PORTLAND, ORE. — An ordinance has been introduced to the City Council providing for an issue of $4,000,000 for the purchase of a large tract of land as a site for a new power plant.

PORTLAND, ORE.—Application has been filed by the Valley Development Company of Portland with the State Engineer for a permit to divert waters of Lake Creek, Clear Fork, Johnson Creek and Glacier Creek for the purpose of generating electricity for transmission to cities and towns for manufacturing, mining and domestic purposes. The company has also asked for permission to construct a reservoir in Lake Creek and Clear Fork.

SALEM, ORE.—John R. Lewis, state engineer, has been advised that the federal government has withdrawn several thousand acres of public lands suitable for water power developments from the Oregon-California Railroad grant acreage. About 100 townships are affected along the Nehalem, Umpqua, Siuslaw, Siletz, Rogue and Smith Rivers and their tributaries.

TOLEDO, ORE.—The Thorsen-Hendricksen Mill Company has been reorganized and its name changed to the Lincoln County Light & Power Company. The plant now supplies electricity in the towns of Toledo and Newport. New equipment, including a 2000-hp. turbine and generator, will be installed. The additional power will be used to operate a large band sawmill which the company will erect in Toledo.

LOS ANGELES, CAL.—Plans are being considered by the City Council for the installation of an electric-lighting system in Fifty-fifth Street, from Budlong to Normandie Avenue. It is proposed to use marbelite standards.

LOS ANGELES, CAL.—The City Council has appropriated $79 000 for extensions to the municipal distribution system to all parts of the harbor sections, including the extension of the power transmission lines of Fish Harbor on Terminal Island, the latter to cost about $34,000.

LOS ANGELES, CAL.—Negotiations are under way between the City Council and the Harbor Commissioners for the lease of property on the harbor boulevard as a site for the proposed new municipal substation which is to furnish energy in the West Basin and Wilmington districts.

MARE ISLAND, CAL.—Bids will be received at the Bureau of Yards and Docks, Washington, D. C., until May 20 for furnishing and installing one 6000- lb. capacity freight elevator and supporting structure in the machine shop extension at the navy yard, Mare Island. Bids will also be received at same time at the navy yard, Mare Island. Drawings and specification No. 2936 may be obtained at the above bureau or the commandant of the navy yard named.

OROVILLE, CAL. — Negotiations are under way between the federal government and the Great Western Power Company of San Francisco for the construction of a hydroelectric plant to cost about $5,000,000.

OROVILLE, CAL.—Plans for the construction of another large hydroelectric plant in the Feather River District have been announced by a group of Oroville men, providing for the conversion of the Great Bald Rock Canyon into a large impounding reservoir. This, it is said, can be accomplished by constructing a dam 1160 ft. in length and 650 ft. high. With this dam a total fall of 1750 ft. can be obtained, capable of developing 166,000 hp. Present plans provide for this development in three units, the first power plant to be located at the foot of the dam. A second power house is proposed for Canyon Creek, while a third plant would be situated near Bidwell Bar. The total cost of the project is estimated at $7,500,000. Among the promoters are: Paul Reicker, civil engineer; W. L. Curran of Oroville; George C. Riley and A. J. Walsh, both of Sacramento.

SAN DIEGO, CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., and at San Diego, Cal., until May 27 for constructing at San Diego, Cal., commandant's house, officers' quarters and barracks for 400 men.

STRATHMORE, CAL.—With the completion of the substation at Strathmore the San Joaquin Light & Power Company will receive energy from the plants of the Mount Whitney Power Company and the Southern California Company. The companies affected by the tie-in at Strathmore are the Mount Whitney Power & Electric, the San Joaquin Light & Power, the Southern California Edison and the San Diego Consolidated Gas & Electric Companies.

VERNAL, UTAH.—The Vernal Milling & Light Company has filed amendments to its charter increasing its capital stock from $100,000 to $150,000.

ARCO, IDAHO.—At an election held recently the proposal to issue $10,000 for the installation of an electric light and power plant was defeated.

MALTA, MONT.—The new electric-lighting system will soon be placed in operation in Malta.

SNOWFLAKE, ARIZ. — Contract has been awarded by the Snowflake & Taylor Irrigation Company for the installation of an electric-light and power plant. As yet none of the equipment has been installed. The company contemplates beginning work on the construction of a hydroelectric plant about July 8. H. T. Lloyd of Wickenburg has the contract.

YUMA, ARIZ.—The Yuma Gas, Light & Power Company has begun work on the installation of a new transformer at its local substation.

Canada

NORTH VANCOUVER, B. C.—The City Council is considering an option on the property of the Nairn Falls Power Company with a view of developing hydroelectric power.

WHITE ROCK, B. C. — Arrangements have been made by the local water works company with the British Columbia Electric Railway, Power & Light Company to equip the local pumping station for electrical operation.

ST. JOHN, N. B.—A new 550-hp. steam power plant will be installed in connection with the new plant now being built by T. McAvity & Sons, Ltd. The company will need a total 1000 hp., of which only 450 hp. can be developed by the present plant.

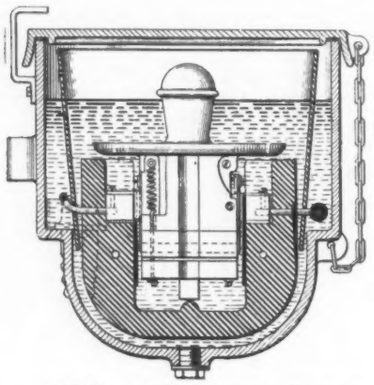
BERWICK, N. S.—The installation of an electric-lighting and power plant to cost about $50,000 is under consideration by the Town Council.

(Issued April 23, 1918.)

14,462 (reissue). Telephone - Exchange System; Talbot G. Martin, Chicago, Ill. App. filed March 21, 1916. Improvement.

14,464 (reissue). Electrical Measuring Instrument: Harold E. Trent, Murraysville, Pa. App. filed Feb. 15, 1916. An ohmmeter having a relatively large range of deflection.

1,263,359. Electrically Heated Cooking Device; Charles C. Armstrong, Marysville, Ohio. App. filed June 27, 1916. Adapted for performing various cooking



1,263,610—Circuit-Opening Device

operations such as broiling, toasting, boiling and frying.

1,263,360. Constant - Current Transformer; Lyman Arnold, Lynn, Mass. App. filed Dec. 13, 1915. Improvements.

1,263,369. Device for Automatic Distribution of a Limited Electrical Effect or Current Intensity Between Lamps, Etc.; Ole S. Bragstad, Trondhjem, Norway. App. filed April 17, 1916. Improvements.

1,263,371. Railroad Block - Signaling Means; Yorke Burgess, Chicago, Ill. App. filed Jan. 15, 1917. Improvements.

1,263,373. Series-Parallel System of Control for Tapped-Field Motors; Frank E. Case, Schenectady, N. Y. App. filed March 24, 1915. Plurality of motors may be operated and controlled.

1,263,376. Telephone-Exchange System; Henry P. Clausen, Mount Vernon, and Charles L. Goodrum, Brooklyn, N. Y. App. filed Nov. 9, 1916. Time required for establishing connections between subscribers reduced.

1,263,377. Electrical Testing System; Henry P. Clausen, Mount Vernon, N. Y. App. filed Feb. 17, 1917. Means for automatically making routine tests of various parts of telephone systems.

1,263,383. Electromagnetic Device; Edward B. Craft, Hackensack, N. J. App. filed Nov. 15, 1915. Rapidly vibrating armature is employed for producing a signal.

1,263,389. Treatment of Gases in Electric Furnaces; Emil Edwin, Christiania, Norway. App. filed Aug. 19, 1916. Improvements.

1,263,390. Treatment of Gases in Electric Furnaces; Emil Edwin, Christiania, Norway. App. filed Aug. 29, 1916. Improvements.

1,263,393. Electrical Measuring Instrument; Alvarado L. R. Ellis, Lynn, Mass. App. filed April 24, 1915. Movable element has a filar suspension.

1,263,402. Telegraph Instrument; Oscar A. Garland, Hot Springs, Ark. App. filed Feb. 26, 1916. For instruction of beginners.

1,263,406. Magnetic Separator; Arthur L. Hadley, Fort Wayne, Ind. App. filed Oct. 7, 1916. For separating magnetic particles from liquids.

1,263,413. Electric Governor; Birger O. Holm-Hansen, Christiania, Norway. App. filed Aug. 9, 1915. For automatic regulation.

1,263,421. Telephone Substation Circuit; Kenneth S. Johnson, Jersey City, N. J. App. filed Sept. 7, 1915. Central-energy type.

1,263,424. Rotary Converter; Laurence D. Jones, Schenectady, N. Y. App. filed Oct. 17, 1917. Improvements.

1,263,429. Telephone-Exchange System; Charles W. Keckler, Newark, N. J. App. filed July 3, 1917. Improvements.

Record of Electrical Patents

Notes on United States Patents

1,263,431. Electrotherapeutic and Exercising Apparatus; John H. Kellogg, Battle Creek, Mich. App. filed March 22, 1917. Improvements.

1,263,436. Rotary Converter; William C. Korthals-Altes, Schenectady, N. Y. App. filed Nov. 6, 1917. Provided with commutating poles and operated in connection with variable voltage boosters.

1,263,437. Double-Pole Rotary Converter; Jens L. La Cour, Vesteras, Sweden. App. filed April 23, 1914. May be used to generate two different kinds of energy.

1,263,481. Telephone Attachment; Albert H. Strock, Oakland, Cal. App. filed Dec. 7, 1915. Improvements.

1,263,500. Storage Battery; Theodore A. Willard, East Cleveland, Ohio. App. filed Oct. 8, 1917. Novel sealing means.

1,263,520. Electric Coupling Device; Thomas R. Brown, Sparkill, N. Y. App. filed Feb. 12, 1914. For automatically connecting the train-wire terminals when cars are coupled together.

1,263,521. Electric Coupling Device; Thomas R. Brown, Sparkill, N. Y. App. filed May 12, 1914. Electric train-line couplings.

1,263,533. Apparatus for the Fixation of Nitrogen; John A. Currie, Toronto, Ontario, Canada. Improvements. App. filed April 8, 1916.

1,263,537. Telephone Transmitters; Aaron Dewinsky, Bethlehem, Pa. App. filed June 30, 1917. Improvements.

1,263,554. Time - Controlled Mechanism; William H. Greenleaf, Hartford, Conn. App. filed Oct. 16, 1916. Small number of parts.

1,263,568. Thermostatic Electric Switch; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Jan. 18, 1917. For use in connection with electrically heated warming pads.

1,263,578. Vehicle Direction Indicator; Israel L. Lowenthal, Minneapolis, Minn. App. filed June 7, 1916. Improvements.

1,263,598. Tungsten-Reducing Furnace; Carl A. Pfanstiehl, Waukegan, Ill. App. filed Oct. 15, 1915. Improvements.

1,263,607. Aluminous Abrasive; Lewis E. Saunders and Ray H. White, Niagara Falls, N. Y. App. filed Dec. 26, 1917. Improvements.

1,263,610. Circuit - Opening Device; Edmund O. Schweitzer and Alfred Herz, Chicago, Ill. App. filed May 29, 1912. Certainty of action.

1,263,615. Ignition and Lighting System for Automobiles; John C. Slager and Harry C. Anderton, Springfield, Ohio. App. filed Aug. 20, 1917. Improvements.

1,263,624. Railway Signaling; William W. Talbert, Chicago, Ill. App. filed June 2, 1913. Improvements.

1,263,628. Device for Shifting Curtains or the Like; Earl K. Vallen, Akron, Ohio. App. filed Jan. 3, 1916. Accomplished by closing of an electric switch.

1,263,642. Starter; Dalmar T. Brownslee, Indianapolis, Ind. App. filed Feb. 15, 1917. For internal-combustion engine.

1,263,657. Electrical Contact Device; Karl Fanta and Norbert Wessely, Vienna, Austria. App. filed May 7, 1914. For controlling the operation of textile machinery according to pattern cards.

1,263,674. Pocket Flashlight; Arnost Janovsky, Brooklyn, N. Y. App. filed Aug. 27, 1917. Improvements.

1,263,694. Magnetic Flywheel; Christopher J. Meyer and Eugene P. Gleason, Milwaukee, Wis. App. filed March 1, 1915. Flywheel and rotary field magnet for a magneto-generator.

1,263,708. Product Containing Alumina and Process of Preparing the Same; Lewis E. Saunders and Ray H. White, Niagara Falls, N. Y. App. filed March 2, 1917. Improvements.

1,263,709. Aluminous Abrasive and Process of Making the Same; Lewis E. Saunders and Ray H. White, Niagara Falls, N. Y. Improvements.

1,263,710. Aluminous Abrasive and Process of Making Same; Lewis E. Saunders and Ray H. White, Niagara Falls, N. Y. App. filed Aug. 2, 1917. Improvements.

1,263,711. Buzzer; Carl J. Schwarze, Adrian, Mich. App. filed Aug. 23, 1917. Electrically operated.

1,263,746. Insulator; William H. Creamer, Leoma, Tenn. App. filed July 20, 1917. For use in stringing light, telegraph and telephone wires.

1,263,783. Adjustable Lamp Support; Frank X. Maier, Sterling, Ill. App. filed Nov. 11, 1916. Improvements.

1,263,855. Winding Machine; Wilbur T. Childs, Akron, Ohio. App. filed Jan. 2, 1915. Capable of rapidly winding a strip helically about an object.

1,263,877. Waterproof Entrance Fitting for Service Conduits; Edgar H. Freeman, Trenton, N. J. App. filed Nov. 6, 1916. Improvements.

1,263,902. Safety Signal for Vehicles; Karl Z. Kiefer, Newark, N. J. App. filed July 3, 1917. Improvements.

1,263,923. Tire-Wrapping Machine; Frank M. Pierce, Chicago, Ill. App. filed Oct. 3, 1914. For use on automobiles.

1,263,924. Double - Wrapper Wrapping Machine; Frank M. Pierce, Chicago, Ill. App. filed Nov. 26, 1915. Improvements.

1,263,927. Combined Electric Stove and Toaster; Harold A. Rice, New York, N. Y. App. filed Sept. 22, 1915. Improvements.

1,263,941. Control of Electrical Discharges from Electrical Conductors; Walter A. Schmidt, Los Angeles, Cal. App. filed July 17, 1911. Improvements.

1,263,959. Anode; Henry R. Swartley, Jr., Manhasset, N. Y. App. filed Feb. 25, 1916. Improvements.

1,263,961. Attachment - Plug Fitting; George B. Thomas, Bridgeport, Conn. App. filed April 20, 1916. Barrier element serves to convert the receptacle into a polarized fitting.

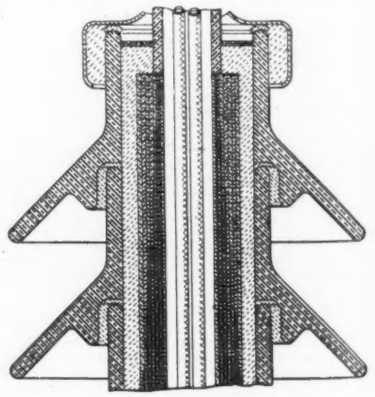
1,263,976. Electrical Apparatus; Frank P. Whitaker, Rugby, England. App. filed Nov. 10, 1916. Alternating-current generators and induction regulators.

1,263,992. Multispeed Alternating - Current Motor; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Dec. 17, 1915. Induction motors.

1,264,021. Electrical System of Distribution; Gorham Crosby, Glen Ridge, N. J. App. filed March 7, 1916. Improvements.

1,264,058. Process and Apparatus for Producing Line Welds; Henry Geisenhoner, Schenectady, N. Y. App. filed Sept. 29, 1916. Improvements.

1,264,086. Impulse Starter; Albert G. Karkau, Cleveland, Ohio. App. filed



1,264,113—Condenser-Type Bushing

March 15, 1916. For use in connection with a magneto.

1,264,113. Condenser-Type Bushing; Jesse E. Mateer, Wilkinsburg, and Howard G. McDonald, Murraysville, Pa. App. filed June 8, 1917. Conducting layers terminate in superposed horizontal planes.

1,264,119. Electric Heater for Oil Wells; Charles A. Neal, Kansas City, Mo. App. filed Jan. 5, 1918. Improvements.